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Gordon
Mah Ung

GIVE THE MOST WONDERFUL GIFT OF ALL

WITH NERDMAS NEARLY UPON US, everyone's thoughts turn to the season of sharing. While we've detailed some awesomely great gifts that would make any PC enthusiast happy, one thing we didn't mention was the greatest gift of all: the PC.

One of the happiest Nerdmas memories I have is unwrapping a shiny, homebrewed IBM PC clone that had an NEC 8MHz V20 chip, a Hercules graphics card, amber CRT, and a whopping—wait for it—5MB hard drive. That PC (which actually followed a VIC-20 and C-64 in previous years) led to adventures online, and a small side job typing friends' homework assignments in WordStar.

Oh, wonderful PC, is there nothing it can't do? Gaming, Internet, video and photo editing, productivity, and giving all-round happiness?

That's why, to the annoyance of my coworkers and wife, I have hoarded every single bit of PC detritus and junk I can over the last few decades. While others may eWaste an old LGA775 motherboard, scoff at a stack of DDR2 modules, and think about smashing open that 160GB Seagate to see what's inside, I've kept them all squirreled away in nooks and crannies around my desk. So much so that my last desk was condemned by our facilities department.

But as the holidays approach, I use that massive pile of scratched and dented cases, 350-watt power supplies, and junky old GeForce and Radeon cards that I've amassed to assemble one or two functional PCs to give away. Sure, they won't be Dream Machine–worthy, or even Dream Machine 2010-worthy, but to the kid trying to "game" on his parent's five-year-old laptop with integrated graphics, a desktop with a Core 2 Duo and obsolete discrete graphics card is an amazing leap forward in computing performance.

Sometimes it's not even about giving an entire PC, either. There are times, as Nerdmas Eve approaches, that I'll use a lock pick and sneak in (technically breaking and entering, but if your intentions are good, that's OK, right?) and replace an old hard drive with an SSD. Or replace the GeForce Ti 4600 with a GeForce GTX 560. I'll even remotely log in to a family friend's PC, run CCleaner, clean up the malware, and defrag the hard drive.

So, as the season of sharing consumes us and you're being crushed by the hordes at the mall in front of the Cinnabon, remember not to overlook the greatest gift of all: the PC.

Gordon Mah Ung is Maximum PC*'s editor-in-chief, senior hardware expert, and all-around muckraker.*

↘ submit your questions to: comments@maximumpc.com

THE NEWS

Nvidia Launches High-End Graphics

Maxwell cards are faster, cooler, and feature-packed

VIDEO CARD MANUFACTURERS have a bit of a problem. Though junkies like us need a constant hardware fix, it turns out the bulk of the audience can get by just fine with gaming on a single 1080p monitor. In fact, you can get respectable performance with a $100 CPU and $150 GPU. Also, the 20nm die shrink they were hoping to get by now has hit a few snags. So, how do you convince this crowd to ante up? Beyond performance, Nvidia answers that question with a menagerie of new features that will launch on high-end Maxwell cards, at least some of which will then trickle down to older Kepler cards.

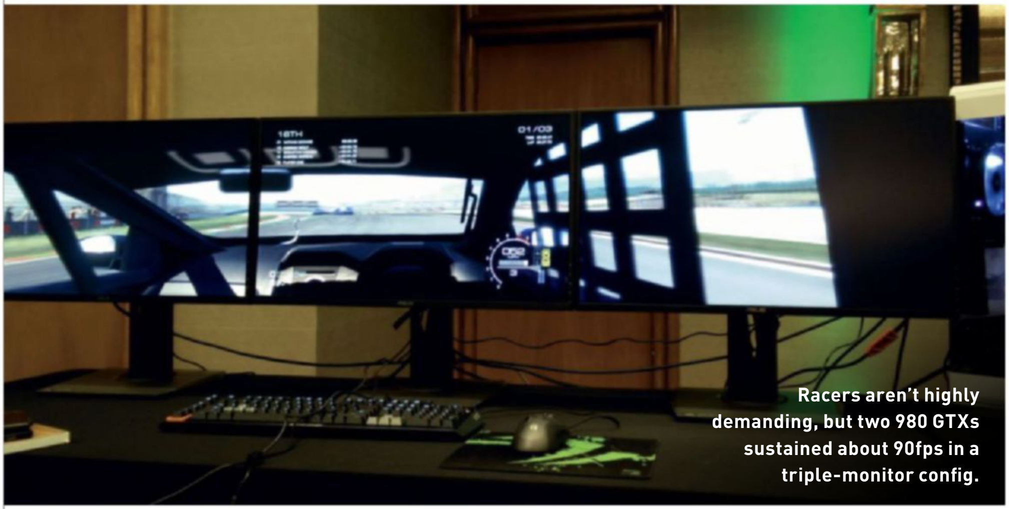
At a September press junket, their opening salvo was a concept called Dynamic Super Resolution (DSR), which combines super-sampling with a post-process filter. (Super-sampling is an antialiasing method that renders a scene larger than the monitor can display, then squishes it down to match.) The filter creates a better result than SSAA alone, but its performance impact is mild. The super-sampling portion is still intensive, though, since you're basically playing at 4K (though you can adjust that downward to 2560x1600). The net effect looks nice on foliage.

Another feature is Multi-Frame Anti-Aliasing. This uses a special sampling technique to get you the visual equivalent of MSAA (multi-sample antialiasing) but with 30 percent better performance, on average. With MFAA, the video card chooses different sampling points from one frame to the next.

Another interesting addition is VXGI, or Voxel Global Illumination. Nvidia positions this as the next generation of lighting models, coming after ambient occlusion. With VXGI, light bounces off surfaces in the scene to illuminate nooks and crannies that would otherwise not be lit as realistically. (In earlier lighting models, light didn't bounce at all.) Nvidia didn't specify the performance impact, because the effect is highly scalable.

Nvidia is also going all-out for VR headsets, with a set of features under a new "Direct VR" umbrella. The main thrust is to reduce latency, the amount of time it takes between moving your head and seeing that movement in-game. They say they've cut the average from 50 to 25 milliseconds. There's also Auto Asynchronous Time Warp, which moves rendered frames to the front of the queue based on how the user is moving their head around, regardless of the game's actual frame rate. Nvidia also has a feature called Auto Stereo, which can force VR functionality when the game isn't specifically coded for it.

The company is also adding features to GameWorks, its development program, which doesn't necessarily require an Nvidia card to take advantage of (but most of its features will be optimized for Nvidia hardware). One of the new features is called Turf Effects, which is a way to render ground foliage without a heavy performance impact (separate from DSR). Another is PhysX Flex, which combines physics calculations for solids, liquids, and gases into a single simulation, allowing these effects to interact with each other in real time. They've also added viscosity and adhesion to the liquid element, so that you're not limited to simulating just water. We'll have a review of the high-end Maxwell stuff in the next issue, so stay tuned. Our review will also be up on www.maximumpc.com by the time you read this. **–TM**



Racers aren't highly demanding, but two 980 GTXs sustained about 90fps in a triple-monitor config.

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MICROSOFT'S $2.5 BILLION SWOOP FOR MINECRAFT

Will multi-platform game finally make its way to Windows Phone?

Minecraft has 100 million PC downloads.

WHEN IT COMES TO billion dollar acquisitions, secrets are hard to suppress. So, it wasn't a huge surprise when rumors claiming Microsoft was about to bag *Minecraft* developer Mojang turned out true. But the stiff $2.5 billion strike price was still a head turner.

The Mojang team will be integrated into Microsoft Studios, where they will continue to work on *Minecraft*. Combined with Microsoft's investments in cloud and mobile technologies, the Redmond outfit says *Minecraft* players will ultimately benefit from richer worlds, more powerful tools, and more opportunities to connect.

"*Minecraft* is more than a great franchise," said Microsoft CEO Satya Nadella. "It's an open world platform, driven by a vibrant community we care deeply about." Microsoft talks about *Minecraft* being one of the most popular games in history (it has 100 million downloads on the PC, it's the most popular online game on Xbox, and it's the top paid app for iOS and Android). But any mention of porting *Minecraft* to Windows Phone is absent.

"Microsoft plans to continue to make *Minecraft* available across all the platforms on which it is available today," said the firm. Pushing it onto Microsoft's own mobile OS seems a no brainer, but when it comes to the Beast of Redmond, all bets are off.

As to what kind of custodian Microsoft will be, it could go either way. Arguably, Microsoft's game-related activities—including Xbox and DirectX APIs—are among its better managed technologies. But $2.5 billion is a hill of money. The pressure to find a return may just bump up against the interests of dedicated Minecrafters in the long run. **–PL**

INCOMING: AMD'S FREESYNC SCREEN TECH

Monitors due in early 2015, GPU compatibility detailed

AMD'S PLANS TO BRING its FreeSync frame rate syncing technology to PC monitors are firming up. FreeSync is AMD's response to Nvidia's G-Sync tech, and promises super smooth gaming performance. Already, the FreeSync-enabling Adaptive-Sync protocol has been included in the upcoming 1.2a update to the DisplayPort interface. Now AMD says key manufacturers of monitor scaler circuits for displays are also on board.

AMD says the new scaler boards will appear in monitors in early 2015 and has also provided a GPU compatibility list. All AMD Radeon graphics cards in the HD 7000, HD 8000, R7, and R9 Series support FreeSync's basic video playback and power-saving features. But you'll need an R9 295X2, 290X, R9 290, R9 285, R7 260X, or R7 260 GPU for the really important bit—dynamic refresh rates in gaming. **–JL**

MICROSOFT BRINGS XBOX ONE CONTROLLER TO WINDOWS

But forgets to make it wireless...

MICROSOFT'S XBOX ONE controller is now available for the PC. Like the version for the Xbox One, it sports over 40 improvements compared to the Xbox 360 controller. It comes with a cable, but it also works wirelessly. Sounds great, right? No. The wireless functionality is only compatible with the console, not the PC. D'oh. Microsoft did release a PC-compatible wireless dongle for the 360 controller, so here's hoping it's a temporary oversight. **–JL**

Tech Tragedies and Triumphs

A monthly snapshot of what's up and down in tech

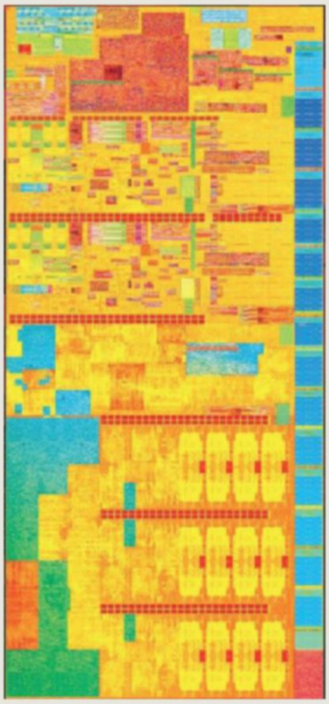
TRIUMPHS	TRAGEDIES
BANDWIDTH BUSTER Microsoft has bumped the file size limit for its OneDrive cloud service from 2GB to a brain-bending 10GB.	**CURVE BALL** Dell announces a new 34-inch monitor with a curved screen. Absolutely nobody—especially us—screams "gimmick!"
HERMETIC HDD While we're talking storage, HGST has upped its HDD ante to a hermetically sealed and helium-filled 10TB. Incredible.	**AMD DOUBLE WHAMMY** With Nvidia turning the screw and Intel on its case, AMD cut prices on both CPUs and graphics. Ouch.
MY EYES! LED monitors fry your eyes, says AOC. Predictably, the monitor maker has a solution: "AntiBlue Light" backlights.	**TOODLE-OO TO TOSH** Toshiba is winding back on its traditional PC business. It plans to stop selling PCs to consumers in some territories. Goodbyeee!

Tom Halfhill

FAST FORWARD

What Intel's Broadwell Reveals

YOU'D NEED A SCANNING ELECTRON MICROSCOPE to see the transistors in Intel's new Broadwell-Y CPU, the ultra-mobile chip also known as Core M. But a bird's-eye view reveals much about its fabrication technology, design decisions, and product strategy. As the world's first microprocessor built in 14nm finFET technology, Core M is a harbinger of things to come.



Broadwell-Y's rectangular shape hints at quad-core chips to come.

My first impression was disappointment: it's a low-power mobile processor for tablets, hybrids, and convertible PCs. Usually, Intel debuts its newest chip-fabrication technology in high-performance server and desktop processors, enabling it to quickly recoup its huge investments. The technology trickles down later into the lower-priced products.

This time, Intel is introducing its new process technology in low-power chips costing less than $300. That's not cheap, but it's a far cry from the thousands of dollars that high-end server processors command. We must wait until next year for the higher-performance desktop version.

AD

One reason for this strategy change is that Intel has achieved a new low in power consumption for a mobile processor with relatively high performance in its class. Broadwell-Y is a dual-core, quad-threaded chip that cruises at 1.1GHz and can turbo to 2.6GHz, yet consumes only 4.5W TDP. Its predecessor, Haswell-Y, consumes more than twice the wattage, but runs at 1.7GHz (base) and 2.[illegible]GHz (turbo). Broadwell uses Intel's new Core M microarchitecture, delivering more performance per watt.

> Intel is feverishly chasing the mobile market and the 14nm advantage is huge. Intel now has second-gen finFET technology while competitors are struggling with first-gen.

Keep in mind that desktop PC sales are flat or declining. Intel is feverishly chasing the fast-growing mobile market and needs every advantage it can get. And the 14nm advantage is huge. Intel now has second-generation finFET technology while competitors are struggling to get their first-generation finFETs into production.

FinFETs can handle higher drive currents, switch between their on/off states at lower voltages, and leak less current. Chip designers can use these characteristics to reach higher clock speeds and/or to reduce power consumption. Intel's 14nm finFETs improve power efficiency by 50–60 percent while shrinking the transistors by about 50 percent. The new fins are taller, narrower, more rectangular, and packed closer together. The metal wiring is slimmer, too, and the cache SRAM cells are almost 50 percent smaller. When the transistors switch off, they leak about half as much current. These are stellar achievements that give Intel the industry's best transistors, hands down.

But Intel delayed the 14nm rollout by about four months because wafer-defect rates were disappointing. Such a delay would hardly be noticed at many chip companies, but Intel operates like Swiss clockwork. It's likely that defect rates were another factor in the decision to debut Broadwell as a mobile processor for a lower-volume market. Smaller chips are less prone to defects.

If you've seen the Broadwell die photos, another interesting feature is its rectangular shape. Most chips are square or nearly so, but the dual-core Broadwell-Y looks like a quad-core chip sliced in half. And that's probably what it is. Don't be surprised if the quad-core version looks like two Broadwell-Y chips glued together.

So, we must wait until 2015 to get a Broadwell quad-core desktop processor that supersedes Haswell. But some things are worth waiting for.

Tom Halfhill was formerly a senior editor for *Byte* magazine and is now an analyst for *Microprocessor Report*.

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Thomas L. McDonald

GAME THEORY

The Personal Touch

***Clash of Clans'* in-app purchases are bad for game design.**

LAST YEAR, George Lucas and Steven Spielberg speculated on the future of film, envisioning a radical shift in the way movies are made and shown. Studios will continue putting all their eggs in the big budget basket, while the mid-budget movie vanishes or finds itself going to video-on-demand, and the low-budget movie goes straight to disc or streaming.

Lucas had a particularly interesting observation: "You're going to end up with fewer theaters, bigger theaters with a lot of nice things. Going to the movies will cost 50 bucks or 100 or 150 bucks, like what Broadway costs today, or a football game. It'll be an expensive thing. [The movies] will sit in the theaters for a year, like a Broadway show does. That will be called the 'movie' business."

This isn't necessarily a bad thing. TV is already doing more interesting things with better writing, acting, and serial storytelling than you'll find in most features, and the long-form structure of many games is in many ways closer to TV than it is to features. (Spielberg, always a canny reader of pop culture, is already working on a *Halo* TV series for broadcast on the Xbox.)

Will we find a similar split in the gaming world? It seems pretty clear that we already are, with the majors turning out only a few types of game right now: big-budget action or RPG titles with multiplayer (massively or not) support, sports franchises, and small games driven by in-app purchases. The last one runs the biggest risk of hurting game design in the long run, with the damage only growing with each success. As *Clash of Clans* rakes in more than $600,000 per day from IAP, the majors aren't going to abandon that toxic formula anytime soon. They're just going to double down.

AD

> As *Clash of Clans* rakes in more than $600,000 per day from in-app purchases, the majors aren't going to abandon that toxic formula anytime soon. They're going to double down.

That leaves the independents to carry the PC gaming torch forward with innovation, personal storytelling, and different perspectives.

I've been following Ludum Dare this month, and it's giving me hope. Ludum Dare runs "game jams" in which people are challenged to make a game with a particular theme, from scratch, in 48 hours. Of course it's a gimmick, but it has the fringe benefit of turning out unusual, quirky, individualistic titles that make up in personality and invention what they lack in polish.

Here are some examples: A man uses a platform-jumping game to explore his mental illness in a gameworld that reverses between light and dark (*Bipolar World*). A simple quest for potato salad, with a bit of bacon, unleashes an interdimensional force of armed pigs (*This Little Piggy*). A woman uses a first person walker to explore the death of her sister (*Dear Sister*). Manipulate your mouse to traverse two worlds—one occupied by a rolling snowball, the other by a floating tentacled creature (*Superdimensional*).

Are any of the games actually any good? Eh, hit and miss. Some have ideas, mechanics, moods, and emotions I've never experienced in a game before, and that makes them interesting, if not always great. But they have something more important: they bear the stamp of their makers' hands. As corporate gaming gets more generic, we're going to come to treasure that human touch.

Thomas L. McDonald is editor-at-large of *Games Magazine*.

THE LIST

7 GAMES WE WANT REMASTERED

7

SYSTEM SHOCK 2

Before *BioShock*, there was *System Shock 2*. The impact of this game and its jaw-dropping plot twist are unforgettable.

6

DEUX EX

Imagine how the original *Deus Ex* would look with *Deus Ex: Human Revolution*'s graphics.

5

THE LONGEST JOURNEY

The game stunned the world with its gorgeous art in 1999. It's time to do that again in the HD era.

The Longest Journey

4

STAR WARS JEDI KNIGHT II: OUTCAST

The best lightsaber-dueling game deserves an equally great HD facelift.

3

BATTLEFIELD 1942

EA, if you're listening, please remake *Battlefield 1942* with the *Battlefield 4* engine (minus the bugs).

2

DESCENT

Of all the games we'd love to play on the Oculus Rift, an HD *Descent* remake tops the list.

PLANE SCAPE
TORMENT

1

PLANESCAPE: TORMENT

Planescape: Torment's story and world are top notch, we just want the graphics to step in line.

geeked at birth

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TALKING

The Truth About Memory

From DDR4 to 1TB USB sticks, Kingston's memory men reveal all in the *Maximum PC* podcast

Does high-clocked RAM actually make your PC faster? Why is RAM so expensive? Will DDR4 be even more expensive than DDR3? What can we expect from future SSD technology? Oh, and what's the story with Kingston's controversial decision to ditch synchronous NAND memory from its V300 SSDs? For all the answers, we cornered Kingston's senior technology manager Mark Tekunoff and public relations manager David Leong in a small room and subjected them to the Minimum BS treatment.

It could be two years before DDR4 prices drop, suggests Tekunoff.

Kingston explains the cost of synchronous NAND is simply too high.

Maximum PC:
What's Kingston's fastest RAM product right now?

David Leong:
Our absolute top-of-the-line memory is HyperX Predator, which we sell at up to 2,800MHz.

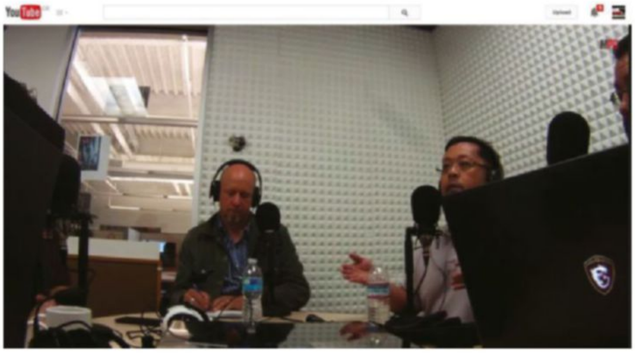
Mark Tekunoff:
We've also done some overclocking up to 4.2GHz with liquid nitrogen at Computex in Taiwan this year. Currently, that's the fastest in the world.

MPC:
On that note, how much extra performance does it actually buy you when you overclock your system memory from, say, 2,600MHz to 4GHz? We get questions about that from our readers all the time, but from the benchmarks we've run, if you're playing games with 1,600MHz or 1,866MHz memory, that's good enough. You'll get 99 percent of the gaming performance of the higher speed stuff.

MT:
There are two different areas—one is usable performance, the other is, "I'm faster than you are." If you're gaming and not doing aggressively memory-intensive stuff like 3D rendering, typically you don't need 3GHz memory. Really 2,133MHz, maybe 1,866MHz in 8GB or 16GB kits, is what most gamers use. But if you want to be the fastest in the world then you push the fastest numbers you can push. But how many of us have a tank of liquid nitrogen sitting in the garage?

MPC:
Tell us about that insane 1TB USB stick.

DL:
Before the 1TB model, our largest capacity stick was 256GB. For the 1TB model we attached the Predator name as its our fastest USB stick. It sells for $700 to $900 depending on the price of NAND memory. And yes, people do actually buy them.



Head to www.maximumpc.com for the full, unabridged podcast.

MPC:
And what about the largest SSD you produce?

DL:
We've announced a near-1TB SSD. It's the V310 and it's 960GB using a Phison 3108 controller [yours for around $550—Ed]. It's aimed right at consumers because we know everybody is moving towards more data. We're all carrying more music, movies, and pictures.

MPC:
What plans do you have for faster, next-generation SSDs?

DL:
Toward the end of this year we need a next-generation controller that can handle 2TB and PCI Express. So those are the next things you're going to see from us, including four-lane M.2 and half-height PCIe SSDs. We're not doing SATA Express.

MPC:
How much faster is M.2 than mSATA?

DL:
Right now it's really dependent on controllers and NAND memory. I wish I could throw a figure out there but we're still working on it. I can tell you that it will be fast.

MPC:
There was some controversy with the Kingston V300 series not too long ago with you guys swapping out the NAND memory from synchronous to asynchronous. Can you comment at all on why that decision was made?

DL:
We're up front about the fact the V300 is the biggest selling SSD from Kingston, the budget SSD. When the V300 first came out, we were able to secure a good supply of NAND and get great performance. We specced it at 450MB/s for reads and writes. That's our baseline spec. So whatever we put in there, that's the minimum you'll get.

Regards the switch from synchronous to asynchronous, we're not affiliated with a semiconductor manufacturer, which means we purchase the PCB, the NAND, the resistors—we put it all together and we make the finished product. When we switched the NAND memory, we maintained the performance spec. We could have maintained the same NAND spec, but would consumers be willing to pay two or three times the price? For us to get to 50 cents a GB or even lower and give consumers the prices they want, this is what we have to do.

The Deets on DDR4

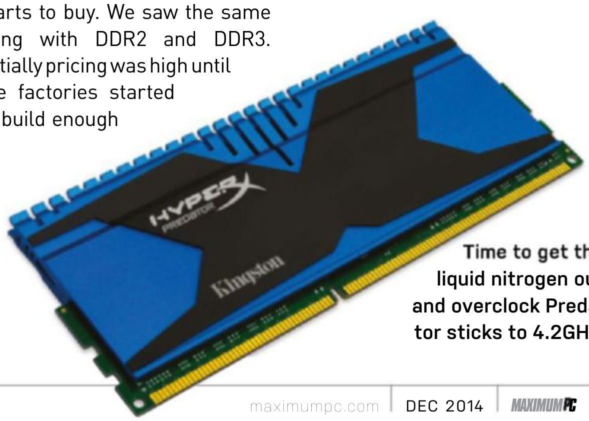
The next major memory standard has finally arrived, but it's premium priced at first

Less power. Faster speeds. More capacity. Win, win, win. That's the elevator pitch for the new DDR4 memory standard. Ironically for us desktop diehards, DDR4 is first appearing where it's arguably needed least—on Intel's new LGA2011-v3 premium platform. What with its quad-channel memory interface, LGA2011 has never exactly been starved of bandwidth. Instead, it's in more mainstream guises—and particularly in mobile PCs with integrated graphics—where DDR4's high-performance and low power consumption will really shine. Pity, then, that we'll have to wait for Intel's Skylake architecture, probably near the end of 2015, to see DDR4 outside of LGA2011 über rigs. Still, at least DDR4 pricing might have eased off a little by then.

Kingston's new V310 is its biggest SSD yet, packing in nearly 1TB.

MPC:
How much should we expect to pay for DDR4? We've seen 32GB kits (4x 8GB) for a hefty $550.

MT:
Right now, we're very early in the life cycle of DDR4, so the prices are still high. Initially, it's not something the general consumer will want due to the cost. But if you're an early adopter, you'll go in and buy DDR4 now. When prices come down to 20 to 40 percent above DDR3, that's when the broader market starts to buy. We saw the same thing with DDR2 and DDR3. Initially pricing was high until the factories started to build enough inventory to lower the pricing to match what the market wanted. If you look at DDR2 to DDR3, it took almost two years for that market to transition, to hit mass market for DDR3. Also, there are just three major DRAM suppliers now—Samsung, Hynix, and Micron. These companies also make flash memory. It's more profitable to make flash with the world moving to a more mobile environment. That means more flash output, less RAM output, so RAM prices go up. ⏻



Time to get the liquid nitrogen out and overclock Predator sticks to 4.2GHz.

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DOCTOR

THIS MONTH THE DOCTOR TACKLES...

> SSDs and AHCI
> 4K Video Cards
> Upgrading RAM

Is There a Merit Badge for That?

I'm trying to donate an old computer to my son's Scout troop. I reinstalled Windows, did all of the updates, installed all of the software they will need, and ran it for a couple of days to ensure everything worked. I took it to their next meeting, plugged it in, and only the green power light would turn on. There was no fan activity, no drive activity, just the light turning on. I brought it home and plugged it in and it booted up just fine. I went over all of the connectors just to be sure everything was connected, stress tested it, took it back, and the same thing happened. I tried 12 different outlets in five different rooms but none of them worked. Also, the old computer they have (Compaq Evo, P4 socket 478) starts up OK. The power supply in the computer I am donating is a PC Power and Cooling 350W. Let me repeat: It works just fine at home, but not in their building.

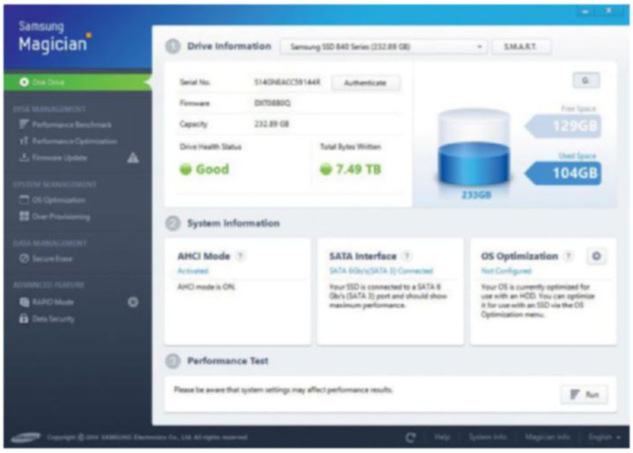
–Thomas R. Matzat

THE DOCTOR RESPONDS: The Doc likes the path of least resistance so he's assuming you brought your own power cable with you. If you didn't, you should, or use the cable from the other PC that does work. The Doc is certain you did that though, so it sounds like an issue with the wiring in the building or perhaps a voltage issue. It's possible the PSU in your PC can't work under certain voltage but that their older Compaq Evo can. It's hard to believe though as that would mean the input power from the building is under 90 volts. If you have a line conditioner or a UPS try your PC with that. Since this is the Boy Scouts, is it possible the building is in a remote location operating on a generator? That can also play havoc with devices. If your PC works with a line conditioner or UPS, that would indicate there's an electrical issue in the building that should be checked by a qualified electrician.

SSDs and AHCI Awkwardness

I have a five-year-old Alienware PC, running on an Asus P6T Deluxe mobo with a Core i7 processor that still performs quite well on most games I play (after a few graphics card replacements). However, I did recently upgrade my main storage from a Velociraptor 300GB hard drive to a Samsung 840 EVO SSD, and I'm having an issue with it. I duly went through the process outlined by the Samsung Data Migration software and hooked the drive up via the provided USB adapter, cloned the drive, detached the old HDD, attached the SSD, and booted. The PC booted with no issues, and the drive works fine, but it seems slower than I had expected. However, when looking at the Samsung Magician software, it says the drive is operating in IDE mode, and not AHCI mode, and it cannot tell me about the SATA interface details. I then went into the BIOS and changed the settings for the hard drive interface to AHCI and rebooted. The system began to boot, did the Windows bloom thing, and then immediately rebooted. I've tried all of the possible settings in the BIOS, attached the drive to a different physical SATA port, and nothing works.

–John Burgess



AHCI mode is ON.

Your SSD is connected to a SATA 6 Gb/s (SATA 3) port and should show maximum performance.

Your OS is currently optimized for use with an HDD. You can optimize it for use with an SSD via the OS Optimization menu.

Please be aware that system settings may affect performance results.

The Samsung Magician utility provides a lot of useful information about your Samsung SSD, and it's a free download.

THE DOCTOR RESPONDS: What you're seeing John is an age-old problem with SSDs, and it's normal. You can't just change the BIOS setting from IDE to AHCI or the system will Blue Screen, as you witnessed. The reason why is the AHCI setting allows new behavior on the SATA port, including Native Command Queuing for the drive and the ability to hot-swap, so you need to have extra drivers installed, depending on the SATA controller in question, which typically occurs during Windows installation. If you try to enable AHCI after Windows is installed, you run into issues, as you've seen. Luckily there's a fix for this, and it involves

↘ submit your questions to: doctor@maximumpc.com

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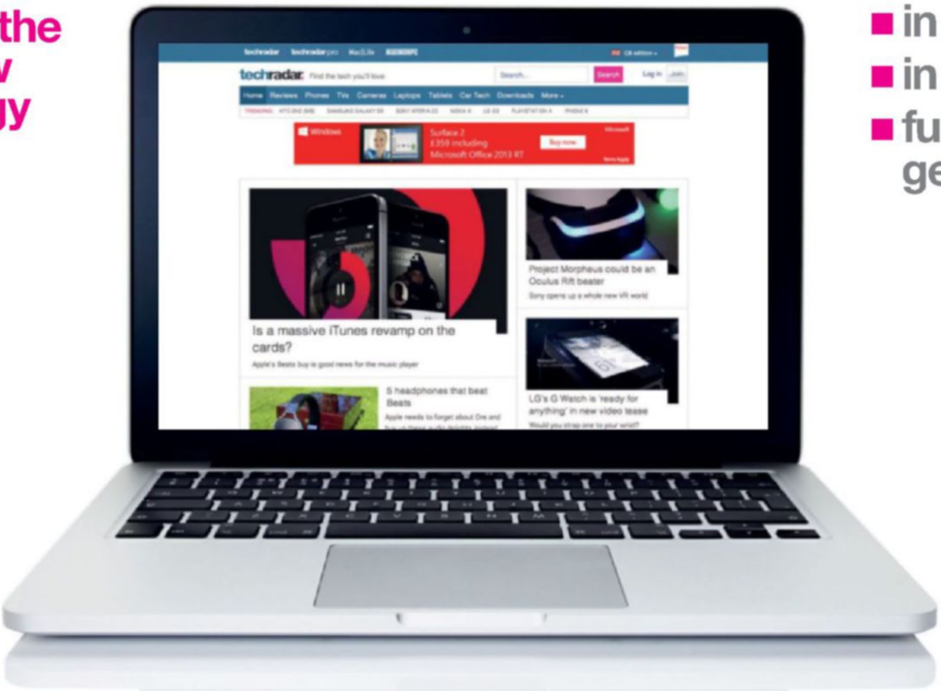
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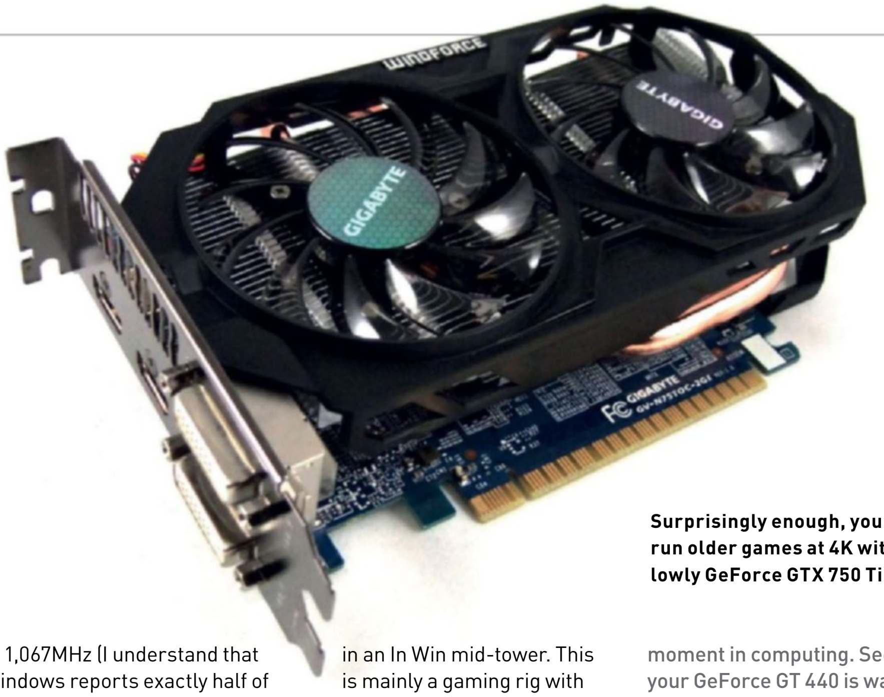
good old registry hacking. The instructions vary according to whether you are using Windows 7 or 8, so we'll refrain from typing them here, but you can easily find them online. Just be sure your data is backed up before messing with the registry.



Surprisingly enough, you can run older games at 4K with a lowly GeForce GTX 750 Ti.

4K on a Budget

I want to upgrade to a 60Hz 4K panel (who doesn't?), and about the most demanding game I run is *Age of Empires II HD* from Steam. I think the maximum resolution my AMD Radeon HD 6870 can display is 2560x1600 and it makes my office get hot during gaming, so I'm looking for a new video card. Do you think an Nvidia GTX 750 Ti would have enough horsepower to run 4K resolution with light gaming, or do I need to go bigger? I want to spend as little as possible and I'm drawn to Maxwell's low TDP.

–Dan

THE DOCTOR RESPONDS: You're right that the AMD Radeon HD 6870 does not do 4K. But luckily for you, we actually have a 4K monitor and an Nvidia GeForce GTX 750 Ti on hand, though we don't know what CPU you're using. We tested the gear with a quad-core Intel Core i5-3470, and we got a solid 60fps when we ran *Age of Empires II HD*. A desktop Core i3 should also get the same results, since the game doesn't use more than two CPU threads. As long as you're not playing recent strategy titles or AAA first-person shooters, the GTX 750 Ti should sustain a good frame rate in less visually complex games.

RAM Upgrade?

I recently upgraded my RAM from Crucial Ballistix Tactical 8GB/1,333MHz to Team Vulcan 8GB/2,133MHz, which is the maximum frequency supported by my board (MSI 970A-G43). I used a program from the Windows store called "PC Benchmark" to check my performance. However, the program reports my RAM is actually slower, as I went from a score of 1,382.4 to 1,197.57. Also, Windows 8's Task Manager is reporting a frequency of 1,067MHz (I understand that Windows reports exactly half of the actual frequency). I thought I observed a slight performance increase in loading certain programs but maybe it was just in my head. Can you tell me what the deal is with my new RAM? I have an AMD FX-8350 CPU, Samsung 840 500GB SSD, and a Radeon HD 7770 GPU.

–Devon

THE DOCTOR RESPONDS: Memory bandwidth rarely gives results you can "feel" outside of synthetic benchmarks. The Doc says this with the caveat that Intel's latest Haswell CPUs do actually pick up some mileage from higher bandwidth memory in checks outside of the synthetic tests. If you want to see the increase in bandwidth, drop in the old RAM and run the free version of Sisoft Sandra. It has a host of tests including a synthetic memory benchmark that should show a nice bump. Will that matter? That's hard to say as outside of encoding and the synthetics, the Doc hasn't seen enough of an increase to warrant paying exorbitant fees for the faster RAM. Again, that's changing as Haswell seems to give performance benefits.

Small Form, Big Hopes

Hey Doc, I'm looking to beef up the system I built in 2011 for *Battlefield 3* gaming. It has an Asus P8P67LE mobo, Intel Core i5-2500 CPU, 8GB of RAM, Asus GT 440, and a 1TB WD Blue HDD in an In Win mid-tower. This is mainly a gaming rig with occasional video editing and Photoshop. Can I transfer this setup to a small form factor case, and if so, what case would fit? I'd also like to install an SSD. Lastly, do I need to upgrade my CPU or just my video card? My budget is $400. Your recommendations will be most appreciated Doc.

–Gerick

THE DOCTOR RESPONDS: You're not going to get a technical small form factor case that takes a full size ATX mobo. There are certainly smaller tower cases that are almost the size of large Micro-ATX boards, but you're not going to get that board in an SFF case. Your best upgrade would be to buy an SSD, a truly life-changing moment in computing. Second, your GeForce GT 440 is way behind the curve, even for *Battlefield 3*. With a budget of $400, the Doc would pick up a 240GB SSD for about $120. That leaves $280 for your video card budget, which could net you AMD's new Radeon R9 285 card. Two things to remember—the R9 285 will consume more power than your GT 440 and will require two six-pin GPU power plugs. If your PSU isn't up to it, you'll have to upgrade that or scale back your graphics ambitions. Or you could peel off from the GPU budget to buy a Radeon R9 270X with a newer PSU or, if you decide against the PSU, you can pick up the power-sipping GeForce GTX 750 Ti. Some GTX 750 Ti cards don't even require external power while some do. So check your PSU first.

[SECOND OPINION]

STOPPING THE SURGE

In the September issue there was a reader who was having issues with the USB Anti-Surge triggering all the time or while playing games. I had similar issues at startup with my Asus P9X79 Deluxe board and couldn't track the issue. I eventually found it to be my UPS causing the problem. The one I was using wasn't certified to be connected with a power supply with active PFC, so I disconnected it from that UPS and the problem vanished. I then purchased a UPS certified for use with PSU's with active PFC, in my case a Corsair AXi 860, and I haven't had the problem since. Just a suggestion for anyone else having that problem and is connected to a UPS.

–Ken Mittelholtz

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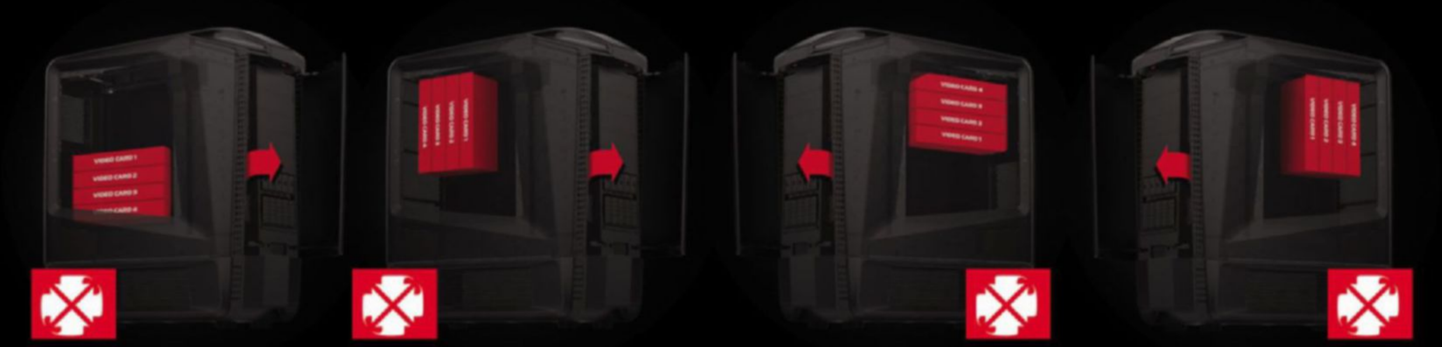

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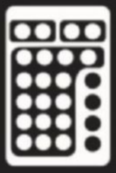

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4K FOR REAL

4K monitors are now affordable. But are they actually the future of PC displays?

BY JEREMY LAIRD

It was around eight years ago that the first 30-inch 2560x1600 pixel monitors burst onto the scene. We were totally blown away by the sheer scale, by the epic desktop real estate. Upgrading from a 22-inch 1680x1050 panel to one of those 30-incher ubertrons was like moving from a tiny room in a shared rental to a private palace of your own. There was no going back.

But what's really remarkable is that those 30-inch beasts remain gorgeous even today. Something like a 30-inch Dell 3007WFP is still a fabulous screen. No other PC component can match that longevity. Imagine gaming on an eight-year-old graphics card. What a joke. So $1,500 spent eight years ago actually looks like good value. Just $175 a year to have a stunning display? Sign us up.

The flip side has been poor progress in PC display technology. Until now. A new generation of even higher-res screens has arrived. We're talking 4K. After a few mega-money panels launched in early 2014, a second wave of more affordable—if not exactly cheap—4Kers has landed. About time, too. Smartphones and tablets have seen pixel counts explode in recent years, making the humble desktop look off the pace—ironic considering it's the PC that stands to benefit most from 4K. Immediately, it gives you more usable desktop space. Then there's gaming. Buy a 4K screen and you can game at 4K right away.

In theory, at least. The snag involves having sufficient graphics power to push all those pixels. More on that later. What definitely isn't possible, or at least isn't yet widely available, is 4K video content. Then there's the challenge to 4K from alternative monitor technology. With super-wide 21:9 aspect screens and clever frame rate syncing tech also appearing, along with higher refresh rates, PC display technology has suddenly woken up. So, is it time to grab a new display for the next decade? Read on to find out.

What is 4K? That's the question and the answer isn't entirely obvious. It's not as simple as defining, say, 1080p. That means 1920x1080 pixels progressively scanned. The end. 4K started as a high-end cinematographic standard involving 4096x2160 pixels and an odd-ball (for video content) 19:10 aspect ratio.

For some diehards, that's what 4K is. Nothing less. But for PC monitors, the reality is 4K has settled on 3840x2160 pixels in 16:9 aspect ratio. So, the broadly accepted definition of 4K boils down to a display with roughly 4,000 horizontal pixels. For PCs, the term UHD or ultra-high definition is also used.

One way to get your head around what 4K delivers is to imagine four 1080p displays on a single panel, because that's precisely what a 4K grid adds up to. Handily, that brings us to our first major sticking point—graphics power for 4K gaming. Running a 4K display is essentially the same as driving four 1080p screens at the same time. It's a huge load on your graphics subsystem.

Asus's 32-inch 4K is too pricey for inclusion here.

UPPING THE ANTE

It's debatable whether there's any single-GPU graphics card currently capable of compromise-free 4K gaming. Factors involve whether you need to run antialiasing with 4K screens and whether non-native interpolation works better with 4K.

> Odds are you'll need to buy at least one new graphics card to make the most of 4K.

The bottom line is that multi-GPU might be a requirement. That puts you in a whole different place when it comes to reliability, stability, and driver support. Multi-GPU has been refined over the years, but it's more complex and remains more likely to generate issues. Even if you're flexible about frame rates and game-engine image quality settings, odds are you'll need to buy at least one new graphics card to make the most of a 4K screen.

Another related issue is display connectivity support. It's surprising but true that not all versions of the DisplayPort interface fully support 4K. DisplayPort 1.1 will do 4K resolutions, but only at 30Hz refresh. You need DisplayPort 1.2 for the full 60Hz. And believe us, a PC display running at 30fps judders painfully. This is somewhat surprising when you consider movies look fine at just 24fps. Whatever the explanation in terms of physics and ocular biology, the result is simple—4K only makes sense with at least 60Hz support.

As for the HDMI and DVI options, the latter is basically a non-starter. For HDMI, it's again a bit complicated. You could use a pair of existing HDMI connections to drive a 4K display as a pair of virtual screens. But that's clunky and throws up problems, especially in games. Ultimately, we'll have to await the arrival of HDMI 2.0 for proper 60Hz single-screen 4K support. Right now, only DisplayPort 1.2 gets the job done properly.

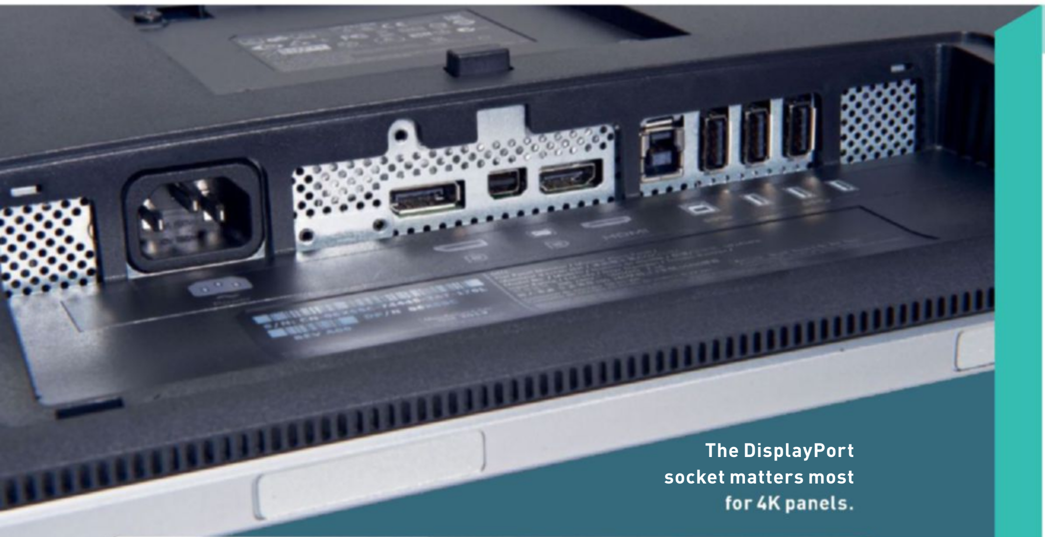
PIXEL POWER

Regardless of the question of in-game frame rates, that's what you'll need from your graphics card just for a decent desktop experience. Once again, that may mean a new graphics card, and in turn will add significantly to the cost of making the move to 4K. With all that in mind, what else do you need to know about 4K?

A critical consideration involves pixel pitch. However you slice it, 4K involves a preposterous number of pixels. No fewer than 8 million. The result is a super-fine pixel pitch on desktop-sized displays as opposed to huge HDTVs. That's part of the appeal of 4K, but it also raises problems for desktop usability.

First up, Windows still doesn't look great when you change global scaling away from one-to-one or 100

Dell's 3007WFP is eight years old, but still a great screen.



The DisplayPort socket matters most for 4K panels.

Vesa mounts give options, but current 4K monitors have adjustable stands.

percent. Most native Windows elements work well enough, but third party apps including web browsers are often interpolated and blurry. More generally, the web is based on bitmapped images and elements that look skanky when scaled, so running at any scaled setting in Windows is deeply suboptimal.

Exactly how much of a problem that is depends on two things—your eyesight and screen size, especially. Currently, 4K monitors range in size from 24- to 32-inches, so that's the same resolution painted across panels of very different sizes.

TN COMES GOOD, TRULY

For us, 24 inches for 4K is out of the question. The pixel pitch is simply too small except for niche activities like professional image editing. Move up to 28-inch and the pixel pitch problem improves but remains marginal. Step up again to 32-inch and things make much more sense. Problem is, 32-inchers currently cost thousands of dollars. For most of us then, going 4K today boils down to the new generation of 28-inch 4K panels that start at a relatively reasonable $550.

Intriguingly, those screens are all based on TN technology, which will ring alarm bells for many. $550-plus for a crappy TN panel? No thanks. But as you'll see from our reviews, TN tech has taken a huge leap forward. These are exciting times for anyone looking for a new monitor. 4K tech does come with problems. But with prices tumbling and the technology maturing, it might be time to buy a screen that lasts you the better part of a decade. Just be sure to check out the alternatives before you pull the 4K trigger.

Panel Picking

4K monitors have landed, but what's happening with broader panel technology? There's Nvidia's clever G-Sync technology that helps smooth out frame rate glitches. Or how about super-wide screens, which deliver a whole new level of immersion.

But all of them are based on familiar LCD technology that's been improving only gradually. The ugly step-daughter of panel tech, aka TN, meanwhile, has taken a huge leap forward with these new 4K screens. Colors and contrast are dramatically better than anything we've seen before from TN. Plus you retain all the quick response goodness typical with TN tech. In fact, the only remaining weakness of true note involves viewing angles—still poor compared to IPS and VA technology.

But we're still talking about a suboptimal solution with pretty much all monitors involving a backlight shining through an LCD matrix. What you really want is individual light sources for each pixel, allowing perfect blacks and more or less perfect viewing angles. The ideal, in other words, is OLED technology. It's been mooted for years as a display technology for PCs, but as yet we've only seen a few pointlessly pricey proof-of-concept products.

In the meantime, OLED has become common in mobile devices and is beginning to enter the HDTV market, where prices remain nearer $10,000. Zero chance of a sane-money OLED monitor anytime soon, then. Of course, the flip side is you can buy a nice LCD monitor, safe in the knowledge it won't look ancient inside six months. Prepare, therefore, to pick your perfect LCD panel panel.

OLED displays are common in mobile devices but are sadly nowhere to be seen in PC monitors.

SPECIFICATIONS

Panel	28-inch TN
Resolution	3840x2160
Viewing angles	170/160°
Contrast	1,000:1
Response	1ms
VESA mount	100 x 100mm

AOC U2868PQU

From bargain bucket to title contender

FIRST, A CONFESSION. Right up until we unboxed the U2868PQU, the idea of a $550 4K monitor from AOC was something of an intellectual uphill climb. Not quite an attack on the K2 summit, more a sweaty saunter up a San Francisco incline.

Not that we're down on AOC, but cheap and cheerful has been our experience with the company to date. A 1080p panel for about $150? By all means, go with AOC. But $550? Not when past AOCs have had dodgy electronics, poverty-spec build quality and catflap-in-a-tornado tilt-only stands. No siree. But just to prove how open-minded we are, brace yourselves for some songs of praise for the U2868PQU. This monitor pretty much implodes all our expectations.

You could argue it's unsurprising this AOC is competitive. A screen is only as good as its LCD panel and, as far as we know, there may only be one 28-inch TN 4K panel being made right now. That means all four 28-inch models we've tested probably use the same panel.

But get this, the AOC looks nicer than the more expensive Asus. Its colors are more vibrant, its blacks inkier. Even its viewing angles seem broader and more stable.

We don't know how this is possible, but one thing is for sure—AOC's track record for poor quality monitor electronics comes to an end with the U2868PQU. Both the black and white scales are excellent by default. This monitor has decent image processing in terms of static quality, no question.

It also has a solid chassis and a fully adjustable stand, which for us is critical at this price point. Oh, and just to add to the upsides, AOC has also seen fit to include a USB hub with USB 3.0 support. Nice touch on such an aggressively priced screen, eh?

CLOSE, BUT NO CIGAR

You also get the full gamut of inputs, including DisplayPort 1.2 for proper 60Hz refresh, DVI, HDMI, and even VGA. In reality you're only going to want to run it on DisplayPort, but the other inputs may come in handy.

So far, so good then. Are there any serious issues? The OSD conforms to the AOC norm, which sadly means it looks crummy, and is brain-meltingly hard to navigate. We could live with that, though; what really spoils the deal here is some input lag.

At first we thought it might be a PC-side issue. But no, the Asus running on the same video card doesn't lag. Neither does the Dell. It doesn't matter what resolution you run at, this AOC always lags a little. Exactly how much that's likely to bother you is tricky to define, but we find it frustrating. It just niggles. In first person shooters it produces that laggy, unresponsive feel that's redolent of games consoles, or when you're running something a little more demanding than your video card can truly cope with.

VERDICT 8

AOC U2868PQU

⊞ **CHEAP THRILLS** Still the budget option despite AOC substantially upping performance; static image quality is a new TN best; USB hub; decent stand.

⊟ **CHEAP FAILS** Just enough input lag to niggle; annoying OSD navigation.

$550, www.tigerdirect.com

SPECIFICATIONS

Panel	28-inch TN
Resolution	3840x2160
Viewing angles	170/160°
Contrast	1,000:1
Response	1ms
VESA mount	100 x 100mm

Asus PB287Q

Leave lag behind with the 4K for gamers

WE'RE OLD HANDS when it comes to PC monitors. Put pretty much any panel in front of us and we usually know what we're looking at without being told. But these new 28-inch TN 4K panels have us flummoxed.

They look a lot like IPS technology. The colors. The contrast. The gradient rendering. We ain't seen TN panels like this before. OK, the viewing angles give the game away, but without that, we'd be mostly fooled. Color depth is where things get really baffling. You see, for this PB287Q panel, Asus is claiming full 10-bit color depth and thus a billion native colors. Not the usual 6-bit plus FRC dithering of previous TN panels, or even 8-bit plus dithering, but true 10-bit.

That's odd, because other 28-inch TN monitors, such as the AOC U2868PQU, claim 10-bit color via 8-bit native color enhanced by dithering. As far as we're aware, there's just one 28-inch TN 4K panel being made and shared by all current monitor models. It's the ChiMei Innolux M280DGJ-L30, and, according to the official spec, it is indeed a 10-bit panel. Why Asus seems to be alone in claiming native 10-bit goodness, we've no clue. As if that wasn't odd enough, it's actually the AOC that subjectively has the nicer image quality. It even seems to have slightly better viewing angles. And all with the same panel? Odd.

Oh, and get this: The Asus, with its native 10-bit panel, has quite obvious banding in color gradients. Yes, really. Meanwhile, the ostensibly 8-bit AOC has little banding, if any. It's all utterly baffling, that's for sure.

LACK OF LAG

Probably less confusing (and certainly the PB287Q's trump card) is the matter of input lag. Subjectively, it doesn't have any, and that makes it a compelling option for gaming. It was actually a blessed relief to hook up the Asus and confirm that not all of these new 28-inch TN 4K panels were laggards.

Does that justify the extra $100? For us it does, despite the marginally inferior image quality. We love gaming and this is the only TN option we'd be completely happy with as a gaming-centric screen.

As for broader features, in the good column are the fully adjustable stand and support for VESA mounting. In the middling column are the DisplayPort 1.2 and dual HDMI ports. And in the bit disappointing column is the lack of a USB hub.

So what does all that mean for the Asus? Like every other panel here, it has strengths and weaknesses. None of its good points score an instant and undeniable home run, but where this Asus screen fails (namely static image quality), it's by a very small margin. Where it wins (namely lack of input lag), it does so rather more decisively.

Yes, it's more expensive than the competition, but we'd rather spend $650 and be happy than blow $550 and feel frustrated.

VERDICT
9

Asus PB287Q

➕ **GAME ON** The best we tested for lacking input lag; 10-bit color depth; fully adjustable stand.

➖ **PONY UP** Higher price but slightly inferior image quality compared to the AOC; no USB hub.

$650, www.newegg.com

SPECIFICATIONS

Panel	24-inch IPS
Resolution	3840x2160
Viewing angles	178/178°
Contrast	1,000:1
Response	8ms
VESA mount	100 x 100mm

Dell UP2414Q

IPS might be king, but size still matters

OVER THE YEARS, Dell has been just about the most frustrating maker of PCs and related gubbins. It's a huge company with epic clout in terms of resources and engineering nous. But much of the time, that know-how is wasted on peculiarly ugly boxes that Dell's mother would struggle to love.

Yet the company still makes a few things for which there is no competition, and its screens often fall into this category. For us, Dell kicked off the modern monitor revolution. It gave us our first taste of both a 24-inch 1920x1200 screen and a 30-inch 2560x1600 display. It pushed the market forward. For that, we're grateful.

So where's Dell with all this 4K shizzle? Oddly offkey, we'd have to say. For proof, look no further than this 24-inch effort, the UP2414Q. Yes, a 24-inch 4K monitor. On the plus side, this is the only display we've tested this month with a top class IPS panel. OK, 4K TN technology has raised its game dramatically, but there's still no substitute for a panel tech that isn't primarily about cost-cutting. IPS is premium through and through; TN is all about saving money.

Still, 3840x2160 pixels is an awful lot for a mere 24-inch panel, and the result is an outrageously fine pixel pitch. High resolution photography looks crazy good. Likewise, games running at 4K look silly. As in silly good. There's just so much detail.

If you had any doubt whether the latest TN panels had closed the gap to IPS for pure image quality, a quick glance at this Dell will settle the matter. It's instantly obvious just how much richer and more vibrant the colors are. TN may have upped its game, but so has IPS. A significant gap remains.

PITCH IMPERFECT

Similarly, there's a clarity to the whites and a depth to blacks that the TN horde can't match. If we were being really picky, we'd say the default factory setting is a little over-saturated and the 6500K color calibration is a touch warm, but such details are easily tweaked. It's no deal-breaker.

We're also happy to report there's no discernible input lag and the pixel response is plenty peppy. Sounds good? Yup, but here's the bad bit. That pixel pitch is fundamentally unworkable for a Windows PC display. While Windows itself scales tolerably well when set beyond 100 percent, most apps and virtually the entire Internet do not.

Even if scaling Windows worked flawlessly, you'd be left with a super high-res display that didn't offer any extra desktop elbow room, which is an odd notion. Then factor in the price, heading towards $900, and the proposition is even less appealing.

It's got a lot going for it, this Dell, but the basic form factor will be a deal-breaker for all but a few people who need something very specific from a secondary display. It's not a real single-screen option.

VERDICT 8

Dell UP2414Q

➕ **MODEL LOOKS** Fabulous display; truly stunning image quality; no input lag; excellent stand and OSD menu.

➖ **MODEL SIZE** At 24 inches, it's simply too small for 4K; expensive.

$860, www.newegg.com

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SPECIFICATIONS

Panel	28-inch TN
Resolution	3840x2160
Viewing angles	170/160°
Contrast	3,000:1
Response	5ms
VESA mount	100 x 100mm

Lenovo ThinkVision Pro2840M

A brand that should know better

MOST OF THE MONITORS tested here get so much right, it seems all the wrongness has been saved for Lenovo's ThinkVision effort. To be clear, this is largely a high quality product from a normally highly reliable brand. The chassis is a nice bit of engineering, as is the fully adjustable stand. Overall, it feels reassuringly expensive.

However, what you're also looking at, largely, is a big mistake. It starts with the glass cover over the screen. It might be a feature Apple customers like, bless their little branded socks, but it's not one that improves a PC monitor. It introduces unwanted reflectivity in return for zero improvement in image quality.

Bad indeed, but not the worst problem. No, that involves this monitor's image-processing chipset. Something has gone seriously wrong here and the default setup is off-the-map wonky, with hideously crushed details in white tones and a similar lack of definition in the black scales. It's compression city. Normally, that kind of thing is the result of a borked factory default setting that can be mitigated through a combo of OSD tweaks and, if necessary, image tweaks using your graphics driver. A pain, but tolerable if all else with the monitor is well. But not here. For starters, the options in the OSD are limited. There's no gamma adjustability and the contrast option is of the sort that really only serves as a secondary brightness adjustment. It doesn't help.

Into the Nvidia driver, then, but that's not helping either. We can't remember the last time we tested a display with such broken default settings that we were unable to arrive at a semi-acceptable solution through the video driver. It's very disappointing.

CRUSHED TO DEATH

In fairness, when you're not looking at test images, the ThinkVision doesn't look awful. It actually looks nice at a glance, but you can't unknow the issues. You will spot the impact of the compression problems from time to time, and it will drive you mental.

In other regards, it's broadly on a par with the rest of the brave new 28-inch 4K brigade. Colors are impressively vibrant for a TN, and even pretty decent by IPS standards. Likewise, black levels and light leakage in general are kept well in check (even if its glass cover tries to disguise that).

As ever, it's the mediocre vertical viewing angles that give the TN game away. Oh yeah, and just in case you aren't already terminally put off, it also suffers from a touch of input lag. Nice. All in all, this isn't a monitor we can come close to recommending. Not even a qualified, "It's OK if you don't mind x and y." Sadly, it's a screen we must warn you away from. With tweaked electronics it might be a goer for anyone wanting a screen with a cover. Until then, run for the hills.

VERDICT 5

Lenovo ThinkVision Pro2840M

+ **CAN TALK THE TALK** It looks like a quality product; colors are vibrant.

− **CAN'T WALK THE WALK** Default settings are irrevocably borked; OSD options are limited; glass cover over screen is annoying; suffers some input lag.

$767, www.shopblt.com

CyberPower recommends Windows

AMD

AMD RADEON GRAPHICS

AMD FX UNLOCKED

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Work easy, play hard Windows 8

SPECIFICATIONS

Panel	28-inch TN
Resolution	3840x2160
Viewing angles	170/160°
Contrast	1,000:1
Response	5ms
VESA mount	100 x 100mm

Philips 288P6LJEB

Say hello to the consumate all-rounder

WITH LENOVO'S BORKTASTIC THINKVISION having ruled itself out, it's a three-way race between our remaining 28-inch 4K offerings. Handily, the Philips Brilliance 288P6LJEB bisects the AOC and Asus models nicely on price.

If you've read the reviews of the other two, you'll know neither quite nails it. The AOC was above expectations—it edges the Asus for static image quality and it's about $100 cheaper—but it suffers from input lag that sees the Asus back in the running.

Wouldn't it be just perfect if the Philips split the difference on price and combined the best attributes of those two panels? Bring it on. For static image quality, it does just that. In the name of full disclosure, we're talking about awfully narrow margins, but the 288P6LJEB does fall roughly between the two. It's probably a little more vibrant than the Asus but subjectively shares its slightly narrower viewing angles. That means that like the other 28-inchers, the quality of color rendering is beyond anything we've seen from TN tech previously.

In fact, the at-a-glance impression is of an IPS panel. If only these TNers had better vertical viewing angles, there would be nothing to give the game away. It really does have lovely subtle-but-detailed colors, with decent black levels and contrast.

Unfortunately, another thing it shares with the AOC, at least, is input lag. It's on about a par with the AOC in terms of the subjective level of the lag, making it annoying rather than catastrophic. All we can really do is warn you of its existence and suggest you try before you buy.

GHOST STORIES

As for what else is of note, the 288P6LJEB gives you the choice of four different levels of pixel overdrive for improved response. Sadly, all but the lowest level introduce some amount of that nasty inverse ghosting thing. The fastest setting is so bad, we wonder why Philips bothered.

The best compromise is the lowest level of overdrive. It noticeably improves response in return for a whiff of inverse ghosting. As for other features, you get a fully adjustable chassis, which is just what you'd expect for a $600-plus monitor.

Input-wise, we're talking the full collection of DisplayPort 1.2, HDMI, DVI, and VGA. As with the other monitors, you'll need a DisplayPort 1.2 compliant video card. Finally, two of the ports in the four-port USB hub support 3.0-style high bandwidth data transfer, just so you know.

All of which makes the 288P6LJEB a nice package, but not outstanding. Apart from a slightly better chassis, it offers little over the AOC. And while it costs less than the Asus, it's less compelling as a gaming panel thanks to that pesky input lag. As ever, you pays your money, you takes your choice.

VERDICT 8

Philips 288P6LJEB

⊞ **TICK THE BOX** Excellent image quality; middle-of-the-road pricing; a good overall package.

⊟ **KEEP IN THE BOX** Suffers from some input lag; not much of an advantage over the cheaper AOC.

$606, www.newegg.com

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4K Frame Rates

Pumping 8 million pixels

Sounds super, doesn't it, 8 million pixels? Problem is, you need to pump 'em at least 30 times every second. That's 240 million pixels that have to be processed by your GPU every single second. Is your graphics card up for it? We spooled up an Nvidia GeForce GTX 780Ti to get a feel for the impact 4K has on frame rates compared to two baseline resolutions—mainstream 1080p and high-end 1600p (or 2560 by 1600 pixels). As our results show, a consoley game such as *GRID 2* hums along nicely, even at ultra settings. But fire up something more visually demanding, such as *Metro: Last Light*, and you get an unplayable 15fps with antialiasing enabled. The average rises to 29 if you dump antialiasing. But you're still looking at minimums as low as 14fps.

Even the GTX 780Ti struggles to cope with 4K.

BENCHMARKS

	Metro: Last Light fps (minimum in brackets)	Grid 2 fps (minimum in brackets)
1080p, antialiasing enabled	52 (19)	128 (101)
1600p, antialiasing enabled	29 (18)	88 (70)
4K, antialiasing enabled	15 (10)	50 (42)
4K, no antialiasing	29 (14)	55 (42)

Test platform: Intel Core i7-4790K, Nvidia Geforce GTX 780Ti, with Intel Z97 chipset.

The 4K Alternatives

So, 4K looks glorious, but it isn't the only new screen tech in town. What about that snazzy Nvidia G-Sync stuff? Or 120Hz-plus refresh rates? And how about the latest 21:9 aspect super-wide panels? The simple truth is that no one monitor today has it all in a single, world-beating panel. Here's our lowdown on the two key alternatives.

Silky smooth, but let down by image quality.

Asus ROG Swift PG278Q

The G-Sync king

This absolutely nails nearly all of our gaming priorities. The 2560x1440 pixel grid is a great compromise between detail and performance. There's 144Hz refresh support for liquid-smooth frame rates, aided handily by Nvidia G-Sync tech. Asus has cooked up a lovely high quality chassis, too. We don't even mind that it's a TN panel. But then we fired it up. It's merely good by usual TN standards in terms of general image quality, meaning it's a super gaming panel, but suffers as an all-rounder.

Immensely immersive, but no G-Sync.

LG 34UM95

Super-wide is super cool

We've seen 21:9 aspect ratio monitors before. But they were 29-inch items with 2560x1080 pixel grids. It's the second number that's the problem. It's really cramped if you're used to 1440p or 1600p monitors and it looks puny next to a 4K panel with 2,160 vertical pixels. But that problem is largely mitigated with this new 34-inch LG and its 3440x1440 pixels. Suddenly all other screens seem like looking out on the world through a small window. With this LG you feel like you're actually living it. Of course, there's no G-Sync or high refresh support. Like we said, there simply isn't a monitor that currently gives you everything.

FINAL VERDICT

A lack of input lag is the critical factor for our recommended 4K panel, the Asus PB287Q.

In recent years, there was a danger any monitor technology roundup would be a dull procession. The field was static, the form factors and resolutions falling into the same old slots. But finally, the 4K revolution has arrived and it's got us back up on our toes.

It just so happens that at the same time, the broader display market has exploded into life. New panel sizes and shapes, innovative technology to improve frame rate syncing and speed up refresh times. For 4K alone, we're having to get our heads around a whole new level of pixel density. The question of what works with the Windows OS and web browsing when pixel pitches get really tiny is one problem. The other major conundrum is whether current graphics cards can cope with 4K pixel grids.

In our view, the answer to the first question goes like this: 24 inches definitely isn't enough physical size for 4K and 28 inches is borderline. So, we'd like to see 4K screens of around 32 inches become more affordable. As for the pixel-pumping thing, the solution is more complex.

In our testing with an Nvidia GeForce GTX 780Ti, the results are mixed. In some games, performance at 4K without antialiasing is comparable with running at 1440p with antialiasing enabled. And thanks to the tight pixel pitch, it's debatable whether antialiasing is really necessary at all on a 4K monitor. It's also interesting just how good 1440p interpolated looks on a 4K panel. It's the first time we've seen any interpolated resolution look decent. So the situation in terms of graphics performance perhaps isn't a total wash. You can buy, say, a $600 GPU to go with a $600 4K screen and achieve decent frame rates at native resolutions in most games, while keeping 1440p interpolated as a fall-back.

With all that in mind, which are the winners and losers from this first batch of relatively affordable 4K beasts? First to fall are the Dell and Lenovo screens, but for totally different reasons. The Dell delivers fabulous image quality but is just too small at 24 inches, while the Lenovo looks like a quality bit of kit, but suffers from seriously borked factory settings. Seeya later!

Among the final three, it's much closer. There's very little to choose between the AOC and Philips displays. Perhaps that's not surprising since they're two brands from the same overall firm. We'd give the edge to the AOC on account of its marginally superior static image quality and slightly lower price, but there's precious little in it.

However, what neither of those two panels can do is provide a lag-free gaming experience, and for us that's a critical, perhaps terminal, failure. The overall spoils, therefore, go to the Asus PB287Q. It can't match the $100-cheaper AOC for static image quality, which is odd given the two screens very likely share the same TN panel. But it's the only one of the new 28-inch 4K brigade to achieve a subjectively lagless performance. We'll give Asus the benefit of the doubt and assume it's paid more attention to the needs of gamers and put extra effort in to ensure input lag isn't an issue. It's the gamer's 4K panel of choice. For that reason it's the 4K panel we recommend. ⏻

The 4K revolution has arrived and it's got us back up on our toes.

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ASUS recommends Windows.

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Holiday Gift Guide

THE BEST GIFTS FOR ANY NERD

BY MAXIMUM PC STAFF

LINKSYS
LINKSYS
LINKSYS
EVGA
GEFORCE
GTX 750 Ti
SC
SAMSUNG
Solid State Drive

With the spirit of Nerdmas nearly upon us, it's that time of year when everyone loses their mind trying to find the perfect gift for that special person. In the shopocalypse that's about to occur, though, you're probably forgetting the hardest person to shop for—you.

Sure, you may be able to suss out just what color shoes your significant other wants this holiday, but it's unlikely your partner, sibling, or parental unit knows what to buy for you. So to save you from receiving the equivalent of a Christmas sweater this holiday season, we've dedicated an entire feature to the absolute best Nerdmas gifts any PC enthusiast would want. Just take this issue of *Maximum PC*, dog ear this page, and then look through the story for what your heart desires. And because circling the item would be too overt, just jot down some notes they won't understand in the margin next to it, such as: "20MB of L3 cache!," "PCIe 3.0," and "1.21 gigawatts."

Then just leave it on the coffee or kitchen table—or in the throne room—and your loved one will pick up on the hints without even knowing they've been carefully socially engineered (our write-ups are even tuned for the gift-giver). And no, they won't even read this intro because we've written it in a language that only nerds are able to understand.

GPU

EVGA GEFORCE GTX 750 TI SUPERCLOCKED

DON'T BELIEVE THE CONSOLE FAN BOYS—you don't need a $1,000 GeForce Titan Black to experience the superiority of the PC platform. One of the best bang-for-the-buck video cards is the GeForce GTX 750 Ti card. It runs modern games at high quality *and* has extremely low power requirements. This particular Superclocked card (part no. 02G-P4-3753-KR) doesn't need to be plugged into the power supply. That means it'll work in just about every PC. It won't play games at Ultra or 4K, but for PC gamers using integrated graphics, this card will make you their hero for the next two years.

www.evga.com; $160

GPU

ASUS RADEON R9 285

IF YOU'RE LOOKING FOR the card for the gamer with a graphics card that's maybe three years old—and looking to balance performance-to-cost—the board to pick is the Radeon R9 285. The specimen you see here is Asus's Strix R9 285, with enhanced cooling. Despite some lower specs, at $250, it's comfortable playing all modern games at 1920x1080 and even has the oomph to run most at 2560x1440. This is the gift to get for a gamer who plays more modern games. Just make sure they have a PSU up to the task. The machine should have at least two PCIe power plugs.

www.asus.com; $250

CPU

INTEL PENTIUM G3258 ANNIVERSARY EDITION

YOU WOULDN'T NORMALLY DESCRIBE Intel CPUs as "fun," but the Pentium G3258 Anniversary Edition is exactly that. This little dual-core chip uses Intel's current Haswell microarchitecture without any Hyper-Threading and not that much cache, but the tradeoff is an unlocked chip for but $70 American. At that cost and with its unlocked multiplier, it's just begging to be overclocked heavily. We've taken our chip from 3.2GHz to 4.7GHz without much effort. Even if you're looking for a gift for a dyed-in-the-wool enthusiast driving a $1,000 CPU, this might be the perfect gift because it'll have them building a new PC just to flog it. It'll get a smile and respect from the nerd who thought you were a clueless tablet user.

www.intel.com; $70

CPU

INTEL CORE I5-4690K OR CORE I7-5820K

WE LOVE THE PENTIUM G3258 part, but it's really not the CPU we'd reach for if you had enough of a budget for an everyday PC that does far more general tasks. The true "every nerd's" CPU is the Core i5-4690K "Devil's Canyon Lite." A quad-core CPU, it has a base speed of 3.5GHz and will Turbo Boost up to 3.9GHz automatically. For 80 percent of us, it's really all you need. And since it's unlocked like the Pentium G3258, the giftee can easily overclock it to a full-time 4GHz without breaking a sweat if they so desire. For big spenders, the next step up would be Intel's new Core i7-5820K CPU. At $390, it's truly the bees knees and, believe it or not, a steal for a six-core CPU. Like the Devil's Canyon Lite, you'll need to bring liquid cooling to the equation, but hey, you can leave that for someone else to give, right?

www.intel.com; $240, $390

CASE

NZXT SOURCE

THERE'S AN EASY WAY to tell if your PC tinkerer is badly in need of a new case enclosure—if the case is beige or looks like it was made by stapling four six-packs of Schlitz together, a new case would brighten up his or her day immensely. Well, a good case doesn't have to break the bank nor be constructed to resemble a shantytown PC. NZXT's Source 210 Elite fulfills that mission. For a measly $50, this case gives the owner the fit, finish, and features previously only provided by cases that cost $100. There are dual 140mm fan mounts (with one included), an intake vent for the power supply, and a door vent for intake or exhaust of air for your GPU hottie. It's big enough for a standard ATX board and has mounts if the builder decides to install a more budget-oriented microATX board instead.

www.nzxt.com; $50

CASE

CORSAIR VENGEANCE C70

SOMETIMES EVEN PC NERDS can admit that looks matter. That's why in many cases, the nerd you're shopping for may find our more budget-friendly Source 210 a little plain. One staff favorite is Corsair's Vengeance C70 in military olive drab, which definitely has more panache. To keep its faux military theme, Corsair even uses case latches similar to what you might find on a Willys Jeep. It's not just looks you're getting for the higher price, though. The case features rubber grommets for cable-routing ports, more fans, a heavier-duty build, and handles on top.

www.corsair.com; $130

COOLER

COOLER MASTER HYPER 212 EVO

IF YOUR NERD'S PC is overheating, too loud, or just in need of a more "muscular" look, nothing says power like an aftermarket cooler that towers above the tiny flower-petal of a cooler already inside the case. Cooler Master's famous Hyper 212 Evo is one of the best bang-for-the-buck pieces of hardware in PC history. When the Hyper 212 line came along, it provided the same or better performance than many air coolers costing twice as much or more. The Hyper 212 reset expectations of just what $29 could net you. It's better suited for those who have a CPU capable of overclocking, and those who just like to make their hardware look fast, too.

www.coolermaster.com; $29

COOLER

CORSAIR H60

LIQUID COOLERS USED TO be about coolant spilled on motherboards and diagrams to figure out where to put your pump and reservoir. Today, liquid cooling using a closed-loop cooler doesn't require maintenance, it's clean, and outperforms anything an air cooler can do. It's not even expensive anymore. The Corsair H60 you see here was used to take our Pentium G2358 all the way to 4.7GHz without so much as a splutter. Combine the Pentium G2358 with the H60 and you'll have your system builder working until midnight the day he or she unwraps the gifts.

www.corsair.com; $63

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MOUSE

ROCCAT KONE XTD

A GAMING MOUSE DOESN'T have to break the bank. Roccat's Kone XTD is a staff fave. It has an 8,200dpi laser sensor, four-color LED customization, and customizable weights. It's on the larger side, and probably best suited to those who grab the entire mouse using a "palm" grip. The surface is rubberized for a non-sweaty feel, and stays grippy. At $74 on the street, the price is even reasonable. But one warning: The mouse is probably the PC's most personalized piece of kit. You'd have better luck trying to pick out a pair of pants for the person without knowing their size. So, any mouse you buy as a present should come with a gift receipt.

www.roccat.org; $74

MOUSE

RAZER OUROBOROS

REMEMBER WHAT WE SAID about how a mouse is extremely personal? That's still true, but Razer's Ouroboros is a pretty good attempt at letting the user tailor grip and feel. This wireless mouse features an 8,200dpi laser and optical sensor and "1,000Hz ultrapolling." Battery life is 12 hours and the mouse has lift-off tracking, too, for those who often pick up the mouse to reposition it. Perhaps more important are the adjustments that can be made. You can change the height of the palm rest and the length of the mouse and swap out between finger grip panels or finger rest panels. This rodent is also fully ambidextrous. It doesn't come cheap, but with its features, we're not surprised.

www.razerzone.com; $150

HEADSET

CORSAIR VENGEANCE 2100

CORSAIR'S HEADSETS HAVE LONG been a favorite of ours and the Vengeance 2100 continues the tradition of just being all-round awesome. There's a lot going for the Vengeance 2100: It's wireless, has a microphone for verbal taunting of others, and is comfy. That last fact is probably one of the least considered but most important, as long sessions of Skype, gaming, or music listening shouldn't make your head damp with sweat. Combined with its superb audio and good bass response, this one is likely to make anyone who unwraps this gift happy.

www.corsair.com; $130

SSD

SAMSUNG 840 EVO

IF THERE'S ONE GIFT every PC enthusiast will enjoy, it's an SSD. If you're not familiar with what an SSD does, just know that it's a game-changing, life-transforming piece of hardware that's probably a better performance upgrade than a new CPU or GPU. Yes, it's that good. For that, we're going to recommend Samsung's tried-and-true 840 EVO 250GB, which falls into the $120 range. It's the best balance of space and price. Even if your nerd has an SSD, you can slide up in capacity to 512GB, or even 1TB if you really want to see a giant smile.

www.samsung.com; $120

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USB 3.0 STORAGE
SANDISK EXTREME PRO USB 3.0

USB THUMB DRIVES HAVE become so common and worthless that we're surprised you don't get 8GB versions free in cereal boxes, or on your doorstep like samples of soap. That doesn't bode well for making this a "wow" category for your nerd loved one. But there are two ways you can do that with a USB thumb drive and SanDisk's Extreme Pro USB 3.0 does both. First, it packs an astounding 128GB of storage, so your giftee can store an insane amount of movies, images, files, and junk on it. Second—and more importantly—it's freaking fast. Plugged into a USB 3.0 port, this sucker will copy files at 260MB/s and write them at 240MB/s. The good news about this gift idea is that'll it's universal: Everyone needs more storage and everyone has USB.

www.sandisk.com; $100

KEYBOARD
LOGITECH G710+

LOGITECH, LONG ASSOCIATED WITH the sins of mushy-membrane keyboards, has seen the light with its G710+. This mechanical keyboard features MX Cherry Brown with noise-dampening rings to quiet the sound of typing. The keys are laser-etched and glow white with adjustable brightness, as well. Surprisingly, at $150 list price (but found for as little as $119 on the street), it's one of Logitech's pricier offerings, but in the world of gaming keyboards with mechanical keys, this pricing is actually standard fare. No matter what, it's a good and sturdy keyboard sure to make anyone who doesn't know the joys of a mechanical keyboard smile.

www.logitech.com; $119

SOFT GIFTS

Sometimes, a soft gift is easier to travel with or send. If you're looking for a way to make the holidays less bulky, here are a few creative ideas to please any nerd

BUY THEM A STEAM GAME

Steam is the world's most popular PC gaming service, so if your giftee plays PC games, they have Steam. You can buy them a Steam gift card from GameStop, Best Buy, Target, Walgreens, or Walmart. But to be more hip, fire up your own Steam account, find your favorite game, and buy it as a gift. It can be sent to your giftee's Steam account or through email if they don't have an account.

GIVE THEM AN ORIGIN GAME

Electronic Arts is a huge company, but its electronic game distro service, Origin, isn't as respected. Still, EA's stable of games is hugely popular, including *The Sims* and *Battlefield*, so a physical gift card from the usual suspects will make any gamer happy. There's no way we know of to gift a game electronically, which makes perfect sense for an electronic download market.

HUMBLE BUNDLE

Strike another line from your gift list, while also getting a great deal and helping raise cash for charity, by buying all your gift games at www.humblebundle.com. It offers deeply discounted prices for games that are donated by publishers, with much of the proceeds going to such outfits as the American Red Cross, Child's Play, and the Electronic Frontier Foundation. Humble Bundles aren't just games anymore, either, you can buy books and more. To make it a gift, check the "gift purchase" box during checkout.

GOOGLE PLAY

We know the vast majority of Android users don't like to buy apps or music, but Google Play cards can be pretty valuable when you're inspired to pay for whatever magic mushroom or egg you need to get you past that one level that has you stuck in *Angry Ferret Epic*.

HYBRID
MICROSOFT SURFACE PRO 3

WHEN YOU MOVE INTO portable devices, you don't want to compromise. In some ways, you can think of Microsoft's Surface 3 as two gifts in one. For one, it's a tablet with a gorgeous high pixel-density touchscreen and pen. And that's a real pen, too—not a capacitive pen you see on iOS or Android tablets. And two: it's a real computer. You can run Word, Excel, Photoshop, and all of the apps you use to do actual work. The cheapest Surface Pro 3 rings in at $800, but we think the "budget" one to have is the Core i5 version with 128GB, even though it adds $200 to the price tag.

www.microsoft.com; $1,000

GAMING LAPTOP
ASUS ROG G750JZ

THIS IS THE BIGGEST-TICKET item in our gift guide but it's capable of plenty. With its quad-core Intel Haswell CPU, GeForce GTX 880M, 256GB SSD, 17-inch screen, and 24GB of RAM, it's a portable gaming rig. It's not thin nor light, but few notebooks that offer any serious level of gaming capability are. This unit is made to be parked on a desk 80 percent of the time and only moved when going to a friend's house for a gaming session. Asus offers several configurations, but the G750JZ-DS71 is our pick as it has the GeForce 880M, an SSD, quad-core CPU, and a 1TB hard drive, too.

www.asus.com; $2,100

ASUS
THE CHOICE OF CHAMPIONS
REPUBLIC OF GAMERS
ASUS

ROUTER
LINKSYS WRT1900AC

RETRO IS IN and Linksys's throwback nod to its iconic WRT54G seems to be central to the new high-end WRT1900AC router. It's a 3x3 design with detachable and upgradeable antennas and supports 802.11ac. With an eye on performance, Linksys went with a dual-core 1.2GHz ARM processor and 256MB of DDR3. Why? The faster the processor, the more capability, and the better the performance. In keeping with the original's embrace by the open source community, Linksys is actively courting the same, but it's been slow going. In a nutshell, the WR1900AC is one of the more powerful routers out there and if Linksys can pull off widespread support, it may end up being popular years after being eclipsed by newer and faster rivals, just like the WRT54G. Translation: It's a nerd's router.

www.linksys.com; $250

TABLET
NVIDIA SHIELD TABLET

IT'S EASIER PICKING toothpaste than a tablet today, but to us, the perfect gift—especially for a person that leans into PC gaming—is Nvidia's Shield Tablet. Sure, it doesn't have the name-brand recognition of Samsung or Google, but it's powerful and hits the 8-inch tablet size that's so popular. And when we say it's powerful, we mean powerful. The Nvidia Tegra K10 inside the Shield Tablet sits atop most of the CPU and graphics benchmarks, so it's a scorcher. It meshes well with Nvidia's gaming ecosystem, too. That means the person who will get the most out of it will be running an Nvidia graphics card. That's easy to find out.

www.nvidia.com; $299

TRINE 2
Complete Story

Stuff Your Socks

WE'D ALL LOVE TO UNWRAP A SHINY NEW $2,200 GAMING LAPTOP, BUT NOT EVERYONE LIVES IN HOMES WITH SOLID-GOLD TOILETS. SO, WE'VE PICKED A HANDFUL OF STOCKING STUFFERS THAT WOULD DELIGHT ANY PC ENTHUSIAST

1. Light up their case with BitFenix Alchemy Connect light strips. **www.bitfenix.com; $25**

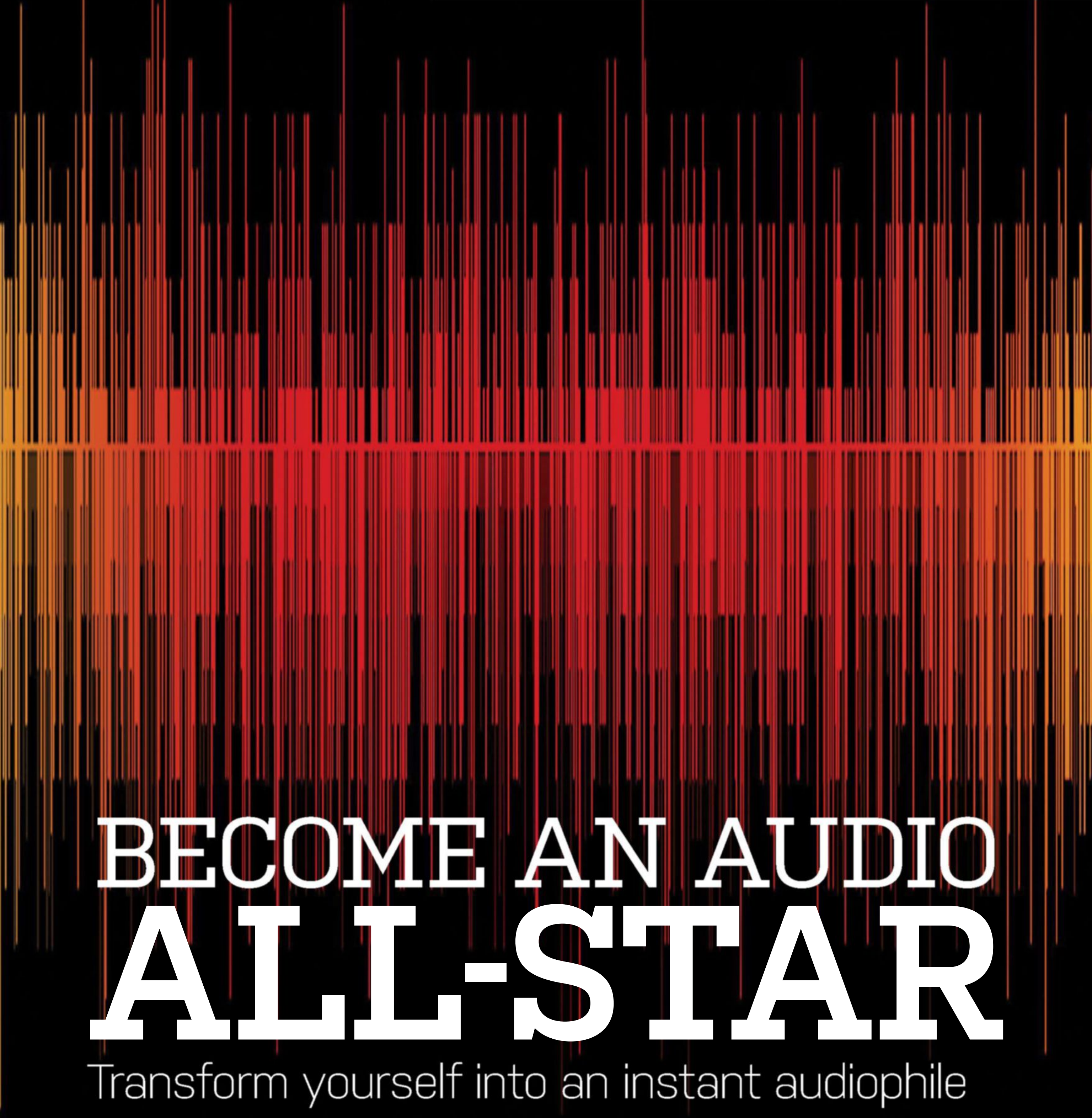
2. Tidy up any SATA wiring instantly with SilverStone's ultra-thin CP11 cables, available in blue and black. **www.silverstone-tek.com; $12**

3. Google's Chromecast is so cheap, it's practically an impulse buy. It's also a top streaming device to plug into a spare HDMI port. **www.google.com; $35**

4. Folding keyboards are never ideal but Perixx's Periboard-805L thin, folding Bluetooth keyboard makes answering long emails on your tablet or phone easy. **www.perixx.com; $35**

5. PC elitists scoff at consoles, but in their hearts, they admit the controllers are useful for some games. The original wired Xbox 360 controller is a great stuffer for your little gamer. **www.microsoft.com; $30**

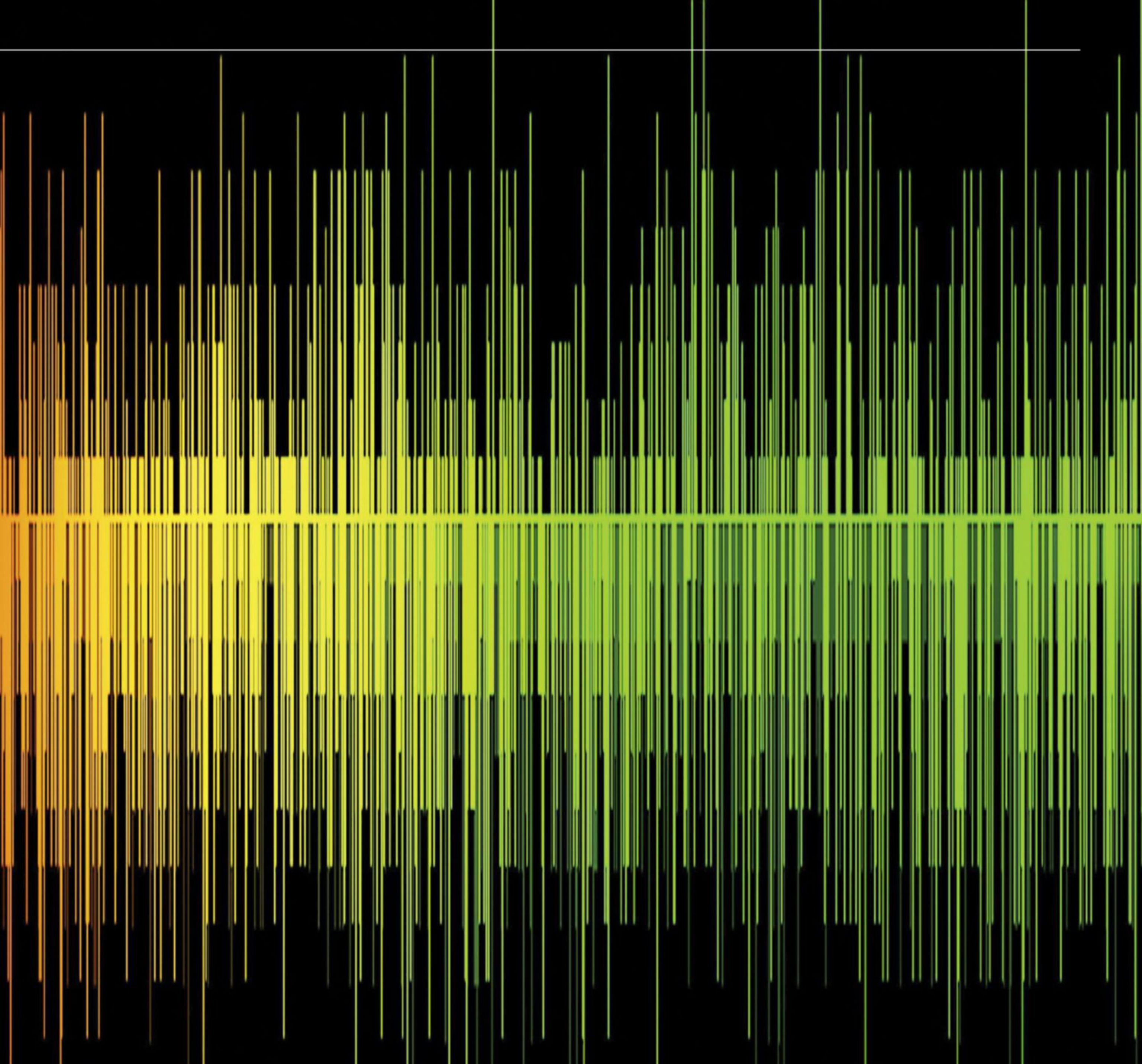
6. Besides, ahem, what you're holding, Amazon's Kindle Paperwhite is the best medium with which to consume text, and will give years of joy. **www.amazon.com; $119 (with ads)**



BECOME AN AUDIO ALL-STAR

Transform yourself into an instant audiophile with these busted myths, decoded codecs, and expert tips for optimizing sound quality

by **James Russell**



Digitized music has made it possible to access your favorite tunes in an instant. Whatever you're into, it's out there in some form or another. Sound is also an integral part of gaming, with melodies, soundscapes, and effects all taking you deeper into the experience. The thing is, audio is intangible. It's very hard to rate in terms of quality. Some people, for example, would pick an early game tune built on primitive architecture over a cinematic orchestral score—it's totally subjective.

But if you've ever wanted to push past the sonic boundaries and become an audio guru, your PC is a good place to start. We'll run you through the basics of what you need to know. You'll learn best practice and rules of thumb so that by the end you'll be able to separate fact from fiction. Just remember, it's a highly personal field and opinion influences everything. The good news is that audio isn't a complex challenge for your PC.

In terms of CPU scheduling, audio tasks are generally relegated to background processes, and setting your processor scheduling up to handle these jobs as a priority is actually a good idea if you want to run audio while using your PC for other duties.

Whether you're looking for a deeper understanding of audio for music, games, films, or anything else, it's possible to beef up your system and get better results, whether it's done from inside the computer or outside. Choosing the right hardware and knowing about digital delivery of sound will fill a lot of gaps, but usually the biggest changes can be made at the final point of the chain—your speakers.

SPEAKERS

Speakers come in all shapes and sizes—from tiny, portable ones to huge, wall-shaking boxes. There are lots to choose from, but how do you cut through the crowd and find the best sound quality?

Single speakers can't give a clear stereo effect.

LIFE IN STEREO

Everyone knows what stereo means, right? It means two channels, one for each speaker. That's very true, but the significant aspect of stereo is the effect it produces through speakers. By turning a sound up in one speaker and down in another, the sound actually appears to move. By having two speakers, individual instruments can be placed in the stereo panorama from right to left at points between the two speakers. Sit between them and close your eyes, and you may be able to point to the position where a vocal or guitar is coming from. Playing a "stereo" file through a phone's speaker(s) can't give a real stereo effect. The panorama would be tiny, with both signals basically coming from the same place. Portable single speakers are much the same, however good the sound "quality." A soundbar has some width, but in terms of a stereo panorama, two speakers further apart perform better.

SHOE BOX FRESH

Portable single speakers may be all the rage, and are good for a holiday or a picnic, but their small size limits their ability to represent music as it was intended to be heard. The stylish designs of these mini Bluetooth machines cast them in all shapes, but the housing of the traditional, rectangular speaker is actually beneficial. Sound coming out from the front of a speaker cone issues backwards too, and the tried-and-tested "shoe box" design is perfectly tuned to reinforce this. That's what the hole on the side is for, in case you were wondering.

BASS INSTINCTS

Anyone who's ever compared the output from a sound system with a subwoofer to one without one will know the huge difference in power these booming boxes can bring. Higher frequency sounds need a smaller speaker that can move very quickly, whereas deeper tones need a bigger, heavier one with more power behind it. The bass we feel from a dedicated low-frequency woofer brings a feeling of weight that's undeniably fuller.

But it's possible to fake this rich sound, at least for a few minutes. Smaller speakers can create artificial bass power. But after five minutes, this can start to drone on, clouding the rest of the music. Nevertheless, that five-minute fake is usually long enough to convince someone in a store that a system has more power than it really does.

SPEAKER NETWORKS

A separate subwoofer is the real deal, especially if you don't like your neighbors. The woofer is where the "1" comes from in 2.1, 5.1, or 7.1 setups. It can also be known as the LFE or "Low Frequency Effects" channel in terms of audio for video, and is often dedicated to "impact sounds" such as explosions and rumbles in movies.

BITRATE BASICS...

How does audio quality stack up when comparing different ways to access it?

If you don't understand bitrate, it's easy to be impressed by a high number. It's time to shed some light on the matter.

The best frame of reference is CD-quality audio. The CD specification was created in the '80s with quality in mind. Its 16-bit resolution is arguably impossible to tell from anything higher, and at 44,100Hz, it can replicate anything we can hear. In terms of bits per second, the benchmark figure is 706Kb/s. Ripping a CD at its highest quality will replicate it like-for-like, but how do today's music playing methods stack up?

One of the most popular music streaming services online is Spotify. Its standard users (paying zilch) get 160Kb/s, while mobile users get even less. Pay for a subscription, though, and the quality rises to 320Kb/s. But the sound quality is good even at 160Kb/s, as the encoding used on Spotify's files is suited for music.

YouTube's audio quality has varied over the years, but the video service now gives audio the attention it deserves, mostly via a 192Kb/s AAC file if your connection is sufficient to keep up. The quality of the audio is independent of the video quality you select, but this hasn't always been the case. In fact, any material that was uploaded before 2011 won't exceed 128Kb/s. YouTube's algorithms are more suited to speech than music if anything, and the stereo information can come out a little mangled if the volume of a piece of music drops suddenly.

Amazon's MP3s have a target rate of 256Kb/s, digital TV allows a variety of formats and qualities, and SoundCloud streaming is good quality (but the files will be processed sonically after uploading).

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Proper surround-sound is essential for movie buffs.

> “A separate subwoofer is the real deal, especially if you don't like your neighbors.”

You've probably heard of active and passive speakers. The latter require the signal to be amplified before input, whereas active ones have an amplifier inside. If you're building a custom setup, active speakers may give you greater versatility—though they will need a power source. Similarly, separate "midrange" and "tweeter" loudspeakers will be more efficient and deliver a better sound quality.

As an ideal setup, your individual speaker units should contain multiple speakers (drivers) and be supplemented by a subwoofer if the units are too small to house a large-diameter speaker cone.

Tiny, stylish speakers don't cut it for audiophiles, unless you're going for a picnic.

FILES AND FORMATS

There's plenty of audio jargon about, and lots of confusion can come from file formats. The root of the problem is the many ways that things are rated and measured, and this usually depends on how it's delivered. Streamed audio is often quoted in kilobits per second—to match Internet speeds—whereas some files are downloaded with a note as to the file type. "This is an AAC file" doesn't say what you need to know about quality, so let's set things straight.

CD-quality audio takes 44,100 16-bit "snapshots" of an audio waveform every second. That's 705.6Kb/s, doubled for stereo signals to make 1.4Mb/s. Compare this to a "standard" MP3 of 128Kb/s. One's bigger. The other has to find data to remove.

Today's highest quality audio could use data up to 17Mb/s, and anything pushing above the CD-quality boundary may be marketed as "HD audio." However, even true audiophiles are unlikely to spot the difference. The high bitrate exists for the production stage, where many studio processes will be applied to audio, which must remain crystal clear throughout.

What about 3D audio? This usually implies that some processing is added to your signal before reaching the speakers. These flashy effects could be said to create depth or to add extra

ALTERNATIVE MEDIA PLAYERS

Fed up with your current setup? Then try one of these

MediaMonkey

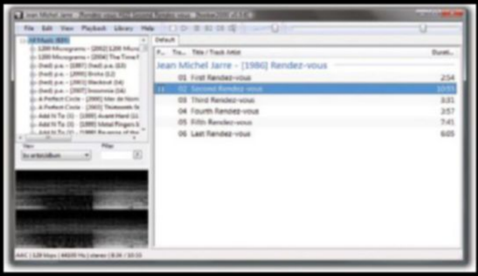
www.mediamonkey.com

Its philosophy is to get your library organized. If you've got badly named files, unknown files, or duplicate files, this could be the one for you.

Foobar2000

www.foobar2000.org

An open source player claiming to be lightweight and customizable. Anyone looking to code their way into their dream player or to search a stash of user-created mods will love this cult player.

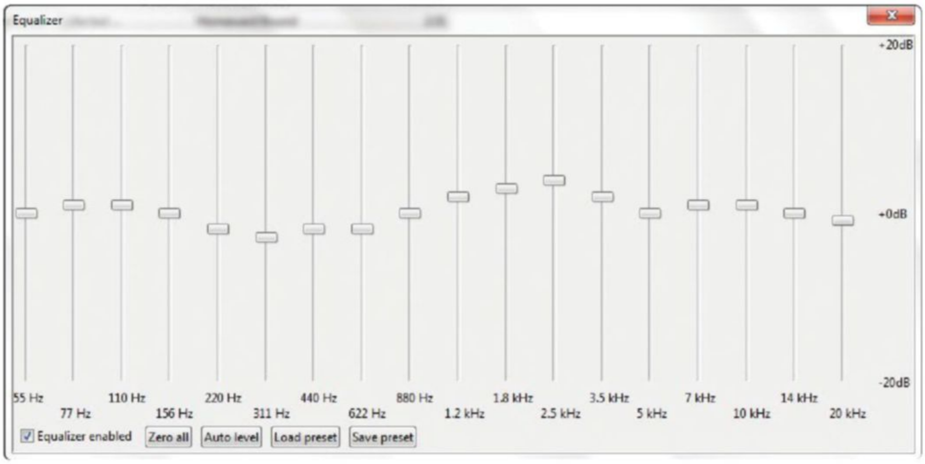


Winamp

www.winamp.com

Reports of Winamp's demise were premature, and the veteran is still trucking after being acquired by Radionomy. It may have become bloated, but it's still a strong choice for those wishing to "do things that Windows Media Player can't." Streaming and a good list of plugins make it a great alternative.

width from where your speakers are placed. They may be fun processes to play around with, but keep in mind that any professionally produced music you buy has been treated with far more complex algorithms already, to the taste of a golden-eared engineer.



Ditch the egg cartons. A graphic equalizer will help compensate for your listening environment.

MP3 EXPLAINED

Back in the days of dial-up 56k Internet, there wasn't much joy in downloading a high-quality music file. The huge size of a "complete" WAV file needed to be reduced, and it couldn't just be squeezed down—that would be audible in the music.

Instead of reducing files' bit rates, scientists developed an algorithm to remove the parts of music files that couldn't be heard, bits masked by other parts of the sound. This left something that, in theory, sounded the same but used less data. A "standard" 128Kb/s MP3 file brings the size down to just under 1MB per minute.

As people got over the joy of simply being able to download audio, flaws in the MP3 format became apparent. The most noticeable problems are a loss of the highest frequency sounds, taking some of the crispness away from cymbals and other bright elements. Anyone who's ever tried listening to low-quality Internet radio may have heard weird, electronic gargling glitches. This is a likely symptom. Another deficit could be a poor quality at the left and right edges of the stereo panorama, which may only become noticeable during quiet moments. The quality of a "lossy" format audio file can only ever be as good as the algorithm used to encode it.

Of course, if a low-quality format is rendered back out as a high-quality one, it'll still sound the same, even if the file size suddenly skyrockets—a bit like resaving a JPEG as a BMP.

CREATIVE
BASS
TREBLE
VOLUME
CREATIVE

Slim speakers can't atone for lack of bass.

FORMAT WARS

The quality of audio encoding is becoming more sophisticated, and bit rates up to 320Kb/s are built into the MP3 format's specification. As well as different ways to encode MP3s, other formats have risen in popularity. The open-source Ogg Vorbis (OGG) format is generally considered better-sounding than an MP3 of the same size, and is supported by most media players. With today's high speed connections and storage capacity, a 35-odd-megabyte WAV or AIFF file download may not be the imposition it once was, but compressed, lossy formats such as MP3 and AAC are still used for streaming audio. To see how different file formats stack up, check the "Bitrate Basics..." box on page 58.

CARDS AND CONNECTIONS

The soundcard isn't an item that goes through yearly renaissances, but there are options. As the bridge between your OS and your speakers, a soundcard only needs to live up to the quality of those two components. In terms of capability, any would-be connoisseurs of "HD audio" will probably be satisfied with something relatively cheap and cheerful. Your choices should be determined by the hardware you're hoping to match it to.

OUTPUT JACKS

A 2.0 or 2.1 sound system will only really need one stereo output jack. A

Multiple drivers in one speaker handle tasks more efficiently.

XPS DJ MONITOR
Hercules
Volume
Bass
Treble

“Remember that any music you buy has been treated with complex algorithms.”

5.1 surround-sound setup requires a card with three output jacks, while a 7.1 system will be supported by a card with four outputs.

It's possible for an external unit (usually your subwoofer) to take a single signal and split it to produce the necessary ".1" information. It's even feasible for a stereo signal to secretly contain more than the standard two channels, which are then decoded from the two-channel signal into more. This is one way to use a soundcard with a single stereo output for surround-sound purposes, but the original stereo file would have had to be encoded in this way in the first place—very unlikely, especially if it's a track you've ripped from a CD.

Digital audio connections could include S/PDIF (using phono or coax connections), ADAT Lightpipe (using optical cabling) or otherwise. S/PDIF is most often used in surround-sound applications, and ADAT is an 8-channel more professional connection.

QUALITY CARDS

While the soundcard market has all but stabilized, there are marks of quality that could be applied. The key component for outputting the best quality signal is the card's digital-to-analog converter (DAC). These don't have an obvious measurement of quality, but as usual, the more expensive the better (though how much difference you'll be able to hear is up for debate). The card's latency (the time is takes to receive audio from Windows and then output it) may be relevant for recording applications, but straightforward listening shouldn't affect your choice. Either way, a lower time is better.

MUSIC APPRECIATION

Some media players, plugins and even speaker systems give you the ability to change your sound. Evolved from the bass/treble controls of consumer gear, these make it possible to boost its best bits. This can be a good way to play with a sound, but keep in mind that a lot of work has already gone into getting it "just right." However, sound effects such as these do have a noticeable benefit in compensating for your environment. It's difficult to escape the effect the dimensions of your room have on the sound coming out of your speakers, but a graphic equalizer (EQ) can help.

Spending time treating the surrounding space can also have a big impact. Forget the myth of sticking egg cartons on the walls, but adding absorptive materials (such as carpets) can make a big difference.

SOUND-BOOSTING MYTHS BUSTED

Learn to shoot down these audio salesmen's tall tales

Gold-plated cables are often peddled for audio applications. The theory is that gold conducts electricity better than the copper used in standard, less expensive cables, and will therefore give you sparkling audio. In reality, this is pretty dubious. If anything, mismatched impedance between circuits could actually make a signal worse.

Sticking with precious substances, it's more and more common to hear claims of "MP3-crystallizing" technology. In theory, this sort of promise could be implemented to reduce some artefacts associated with MP3's lossy compression, but it wouldn't be able to put back any of the information that was removed in the creation of the file. This removed material is hugely variable, and it should theoretically be inaudible anyway.

Common advice back in the day was to stash your Discman in the freezer. The reason? A good chilling would result in a larger dynamic range and less background noise. However, as well as a PC being far harder to get below zero, this won't improve an audio signal, especially a digital one. Besides, you'd need to stash your deep-pan Hawaiians somewhere else.

How about surround-sound headphones? These virtual-reality cans have a lot to answer for. There are no genuine tricks that can fool the ear into thinking there are more directions at play when one speaker is right next to each of their ears, although surround-sound could be theoretically possible using multiple, small loudspeakers placed within one headphone.

As for new technology on the horizon, commentators recently speculated that Apple may replace headphone jacks with digital ports, presumably to allow mic/headphone/speaker combinations. If this comes true, there's no doubt people will start moaning about "that old copper wire connection, the 3.5mm jack plug" and how bad it was. The jury is out on this myth, but it won't be for long.

Gold-plated cables improve sound? Think again.

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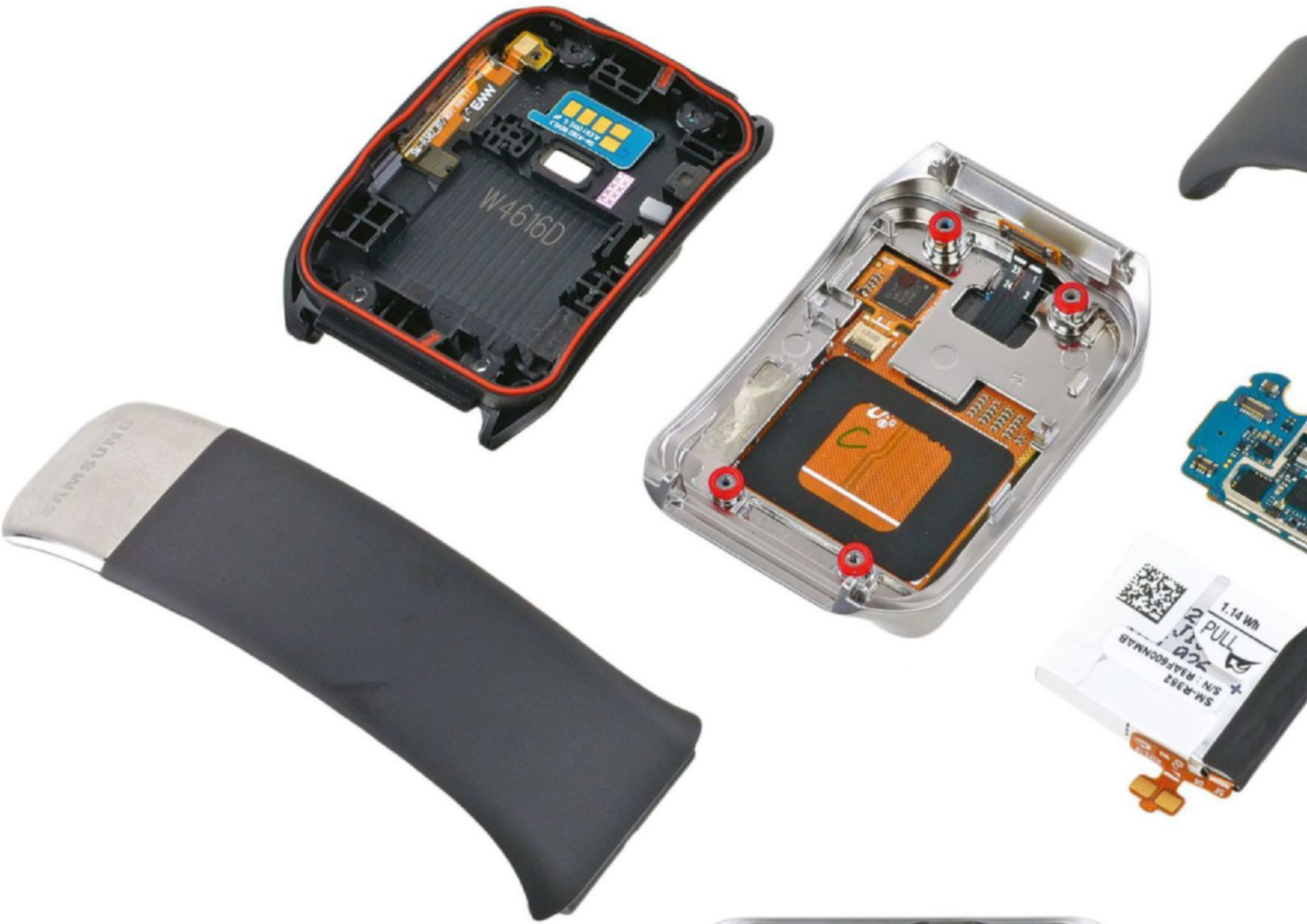
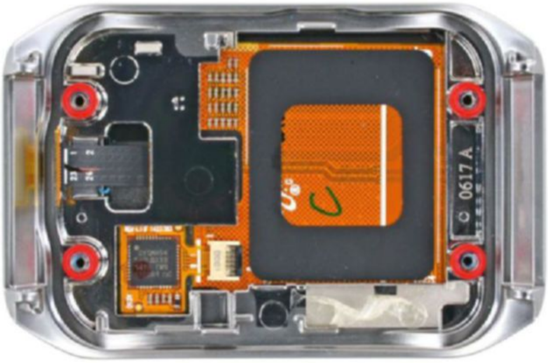
THIS MONTH WE DISSECT...

Samsung Gear Live





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iFixit is a global community of tinkerers dedicated to helping people fix things through free online repair manuals and teardowns. iFixit believes that everyone has the right to maintain and repair their own products. To learn more, visit www.ifixit.com.

BACKGROUND:

Is the future of computing wearable? It is if you go by all the big names now bashing out wrist-borne devices like the new Samsung Gear Live. And now Apple's in on the wearable game with its Watch, too, the odds just shortened on widespread adoption. Killer apps for these wearables are as yet unclear, but there's no doubting they're a marvel of modern science in terms of engineering and packaging. Who's to say the wrist PC isn't just around the corner?

MAJOR TECH SPECS:

- 1.63-inch Super AMOLED display, 320x320 pixel resolution
- 1.2GHz processor
- 300mAh battery (one day battery life)
- 4GB internal flash memory storage, 512MB RAM
- Digital compass, accelerometer, gyroscope, heart monitor
- Bluetooth 4.0 Low Energy

KEY FINDINGS:

- Off come the Torx T5 screws on the back. Unbeknownst to unsuspecting fixers, these otherwise amiable T5 screws are non-magnetic. Curses! We've often seen a single non-magnetized screw in iPhones, near the digital compass—this may be a clever trick to avoid interference with the sensor.
- The battery inscription says "1.14Wh." According to mathemagics and a 300mAh battery, we conclude this watch runs on a fairly standard 3.8V design.
- What's this? A Bluetooth/Wi-Fi antenna? This thing isn't supposed to have Wi-Fi! Perhaps Samsung is hiding something for the future.
- Also notable is the liquid damage indicator. Although this device is "IP67 water resistant," we don't necessarily recommend taking it in the pool.
- The highlights include: a Broadcom BCM4334W Bluetooth 4.0/802.11 a/b/g/n Wi-Fi/FM Receiver; an STMicroelectronics STM32F401B ARM-Cortex M4 MCU with 128KB Flash; a Samsung KMF5X0005A-A210 512 MB DRAM package with the Qualcomm APQ8026 System on Chip layered beneath; an InvenSense MP92M 9-axis gyro, accelerometer, and compass; an InvenSense ICS-43430 microphone; and a Cypress Semiconductor CYTMA545 touchscreen controller.
- Repairability Score: 8 out of 10 (10 is easiest to repair). The band detaches readily, and more or less like a regular watch—making replacements a worry-free affair. Despite the water-resistant construction, opening the case is no big deal. Bring your T5 driver and pry tools, but don't expect a fight. The battery is readily accessed and replaced, with a friendly "Pull" tab to cheer you along. Several small adhered-in flexible PCBs will present a challenge during repairs. The fused display assembly, glued right into the chassis, makes screen replacement a costly proposition.

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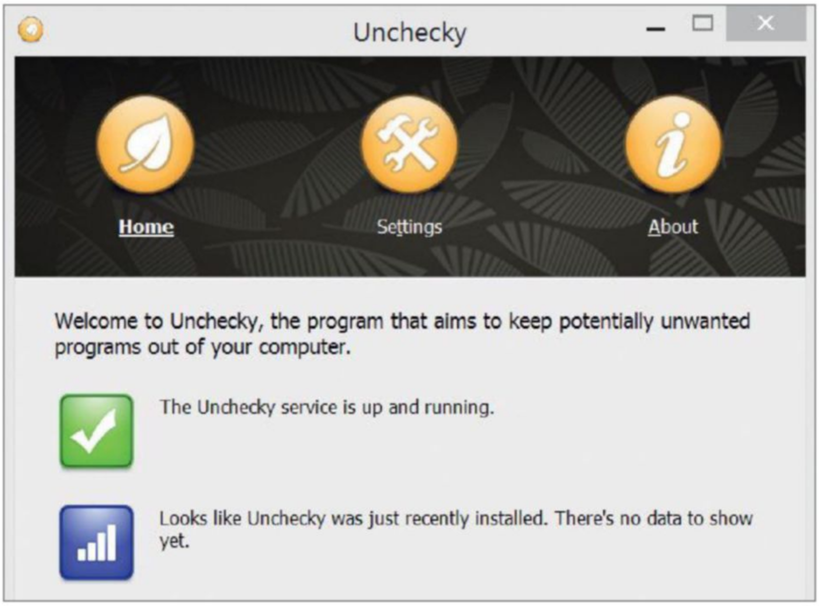
HOW TO

STEP-BY-STEP GUIDES TO IMPROVING YOUR PC

WINDOWS TIP OF THE MONTH



Welcome to Unchecky, the program that aims to keep potentially unwanted programs out of your computer.

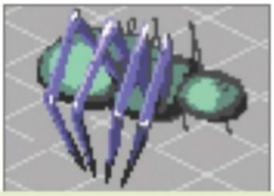
The Unchecky service is up and running.

Looks like Unchecky was just recently installed. There's no data to show yet.

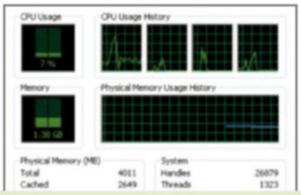
AUTOMATICALLY UNCHECK SPAMMY INSTALLATION OPTIONS WITH UNCHECKY

If you've installed a free Windows app or utility in the last decade, you've met the dreaded spam checkbox—a seemingly innocuous checkbox in the installer, which, when clicked, installs a toolbar or some other piece of spam-ware. To banish these menaces, try Unchecky (www.unchecky.com). This free app automatically unchecks every adware checkbox in most installation dialogues.

MAKE – USE – CREATE



68
Create retro
pixel art



71
Speed up your PC
in five minutes

ALEX CASTLE
CONTRIBUTING EDITOR

MAKING WIKIPEDIA BETTER WITH WIKIWAND

In my professional opinion, as someone who trawls the Internet all day, Wikipedia is basically the best thing ever. That might sound like a superlative, but I really think there's a case to be made that the Wikipedia project is the best thing to come out of the Internet, and one of the most important innovations of all time.

That said, the online encyclopedia is far from perfect. In particular, its presentation feels like it's stuck in the last decade. That's why I was thrilled to discover WikiWand, a free browser extension that changes how Wiki articles render.

With WikiWand, Wikipedia pages render noticeably faster, and look absolutely gorgeous. The design is modernized, with full-bleed images, more readable text, and a dynamic navigation bar at the left. When you mouse over a link to another Wikipedia article, a helpful pop-up shows you a brief preview of that page. In total, it's a much improved user experience, and it's available for free for Chrome, Firefox, and Safari at www.wikiwand.com.

↘ submit your How To project idea to: comments@maximumpc.com

Create Retro Pixel Art

YOU'LL NEED THIS

GIMP
A free GNU Image Manipulation Program (www.gimp.org).

THINK OF RETRO VIDEOGAMES and you'll probably start reminiscing about the pixelated look of games such as *Bomberman* and *Kid Icarus*, which worked within the limitations of '80s technology, yet still offered iconic designs and hours of fun. The style faded with the development of more powerful consoles but has seen a renaissance in indie games. However, while still drawn pixel-by-pixel, the art is now smoother thanks to careful shading and more muted hues not available to developers of old. One of the most popular uses of pixel art is in role-playing games, so we'll create an '80s-style character (or sprite) for use in such a game. –CATHERINE EMMA ELLIS

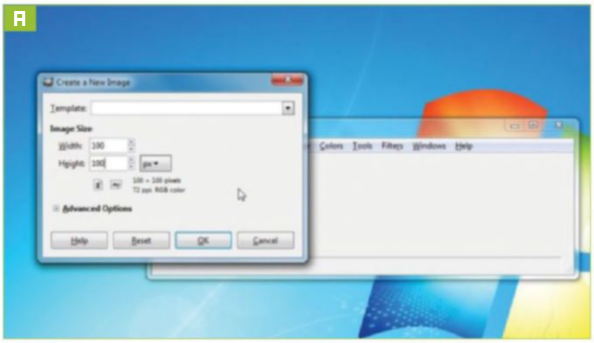
1 PREPARE YOUR CANVAS

Start by downloading and installing GIMP (www.gimp.org), then create a new image (**Image A**). A canvas size of 100x100 is plenty—larger pieces of pixel art are impressive, but take weeks to complete. Now select the "Pencil" tool. This, "Fill," and "Zoom" are the only tools required, but we need to alter some settings so we can draw individual pixels.

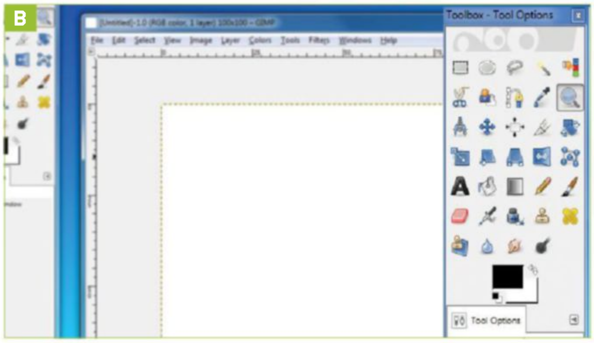
» With the "Pencil" selected, click "Brush Type" and select "1 pixel." Change the size to "1" and turn dynamics off. Deselect "Apply Jitter" and "Smooth Stroke." You can save it as a preset by clicking the blue floppy disk icon at the bottom left of the toolbox. Click on "New Tool Preset," give it a handy name like "Pixel art," then click on the floppy disk icon to save it.

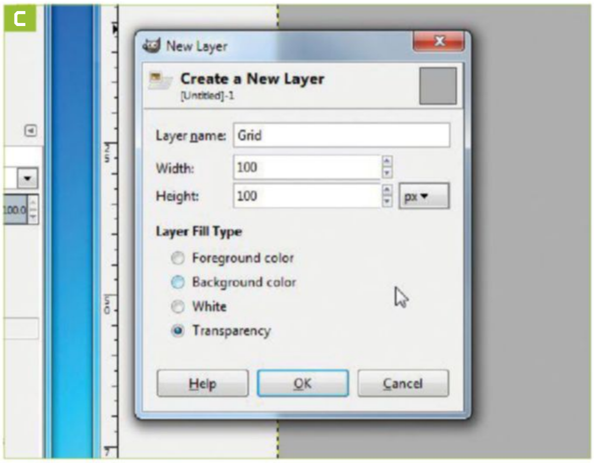
» Use the "Zoom" tool to take a closer look at your image (about 550 percent should be fine, but it will depend on your monitor's resolution). You want to be able to see and manipulate each pixel easily (**Image B**). Make sure you zoom out periodically while you're working to check your art looks OK when viewed at actual size.

» You need to make careful use of shadows and highlights to ensure your pixel art character looks 3D. Select the "Bucket Fill" tool and make the whole image a medium gray color. This neutral background shade will make it easier to judge how bright to make highlights and how dark to make shadows.


A
Create a New Image
Template:
Image Size
Advanced Options
Help
Reset
OK
Cancel
Colors Tools Filters Windows Help

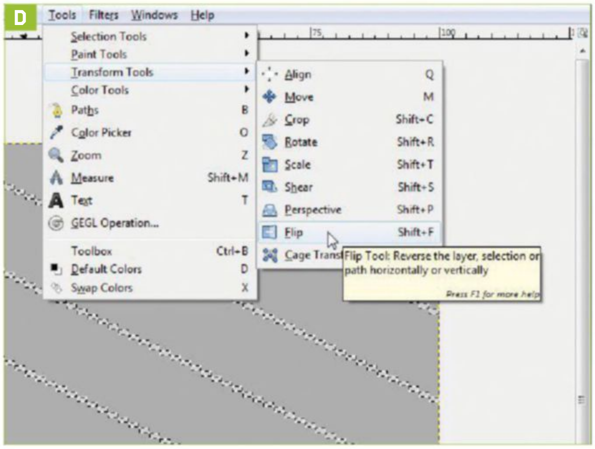
Width: 100
Height: 100
px


B
[Untitled]-1.0 (RGB color, 1 layer) 100x100 – GIMP
File Edit Select View Image Layer Colors Tools Filters Windows Help
Toolbox - Tool Options
Tool Options


C
New Layer
Create a New Layer
[Untitled]-1
Layer Fill Type
Help
OK
Cancel

Layer name: Grid
Width: 100
Height: 100
px

○ Foreground color
○ Background color
○ White
● Transparency


D
Tools Filters Windows Help
Selection Tools
Paint Tools
Transform Tools
Color Tools
Paths B
Color Picker O
Zoom Z
Measure Shift+M
Text T
GEGL Operation...
Toolbox Ctrl+B
Default Colors D
Swap Colors X
Align Q
Move M
Crop Shift+C
Rotate Shift+R
Scale Shift+T
Shear Shift+S
Perspective Shift+P
Flip Shift+F
Cage Transform
Press F1 for more help

Flip Tool: Reverse the layer, selection or path horizontally or vertically

2 BUILD A GRID

Now you need to create an isometric grid. Create a new layer and call it "Grid" (**Image C**). Select "Pencil" and choose a different shade of gray. Now click the top left pixel of your image, hold Shift and move your mouse pointer to the right-hand side. When the co-ordinates at the bottom left read "99 49," click to draw a line. Click Ctrl + C to copy the line and Ctrl + V to paste it, then select the "Move" tool and move the pasted line below the original. Click on the background to deselect the line, then copy and paste both lines. Repeat the process until the image is filled with evenly spaced diagonal lines.

» Now copy and paste all the diagonal lines, but don't deselect them. Instead, click "Tools → Transform tools → Flip" (**Image D**). Click once anywhere on your image to flip the copied lines. This will give you an isometric grid. Because it's on its own layer, you'll be able to delete it easily when you've finished.

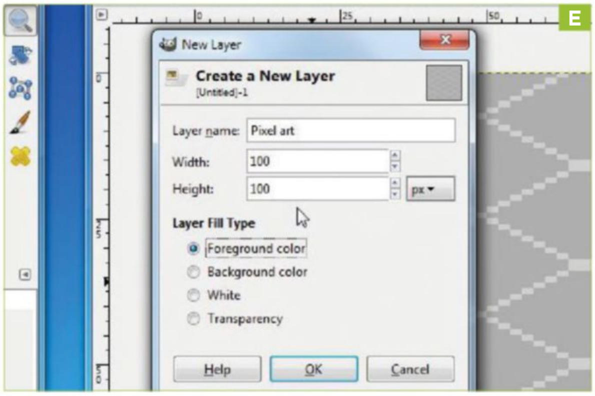
3

SKETCH IT OUT

Create a new layer and call it "Pixel art" (**Image E**). The next step is largely up to you, but we're going to draw a spider-like creature. Make sure you use the grid as a guide to help you get the right perspective, and don't use any tools other than your customized "Pencil" and "Bucket Fill."

» Take a leaf out of the classic artist's textbook and start simple. Rather than trying to get every pixel perfect first time, make a rough sketch of your idea (**Image F**). It's very easy to edit and refine as you go along. Just make sure you use the isometric grid as a guide, and always bear in mind that your character is a three-dimensional object.

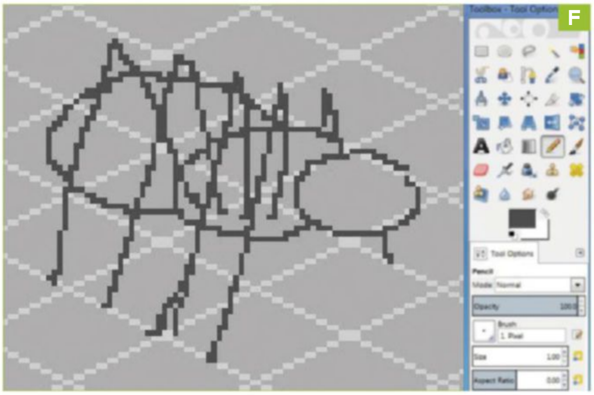
» Once you've got a rough sketch, try filling each section with a different color to make them easier to identify. You can then decide where your light source is and begin adding shades and highlights accordingly (**Image G**). Feel free to tweak; here we've decided to make our spider's legs tilt inward to make it look more alien.

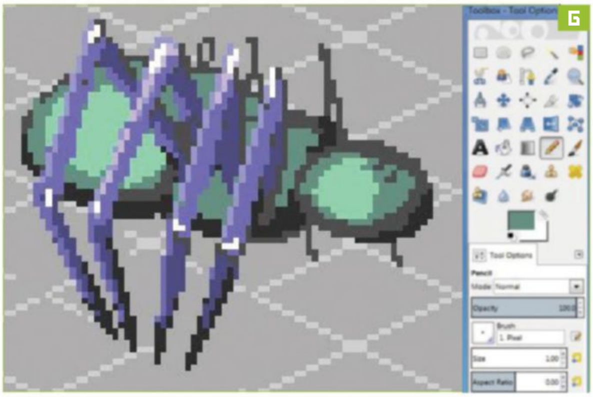


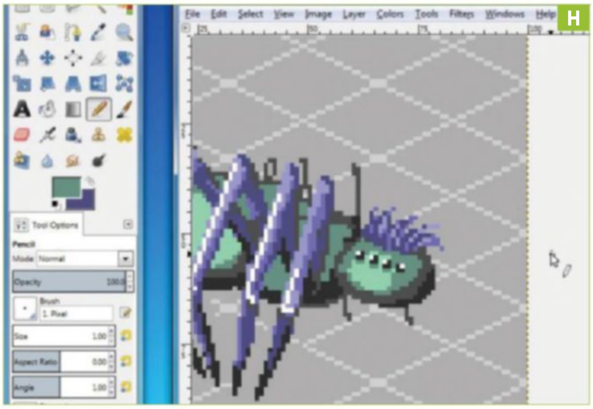
Create a New Layer
[Untitled]-1

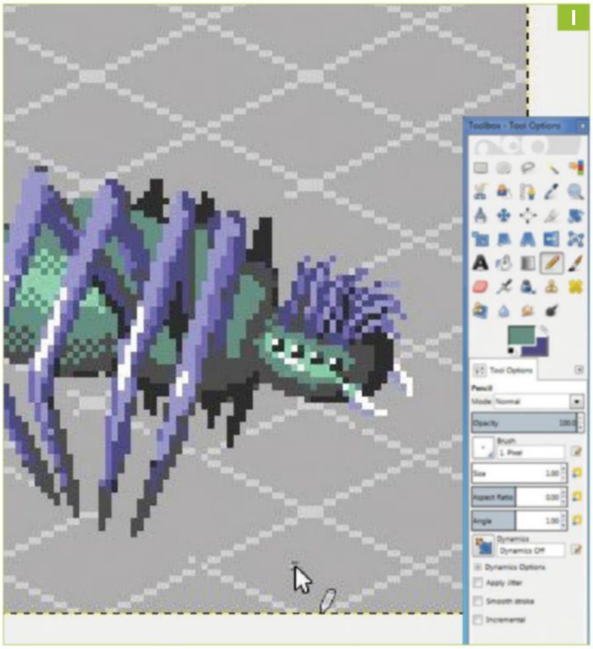
Layer name: Pixel art
Width: 100
Height: 100 px

Layer Fill Type
● Foreground color
○ Background color
○ White
○ Transparency






H
File Edit Select View Image Layer Colors Tools Filters Windows Help



4

ADD TEXTURE

Try to create the impression of different textures rather than making your character uniformly smooth. Here, we've decided to give our spider some fur on its head, using "strokes" of differing shades to represent sections of hair (**Image H**). Zoom out regularly to check your texture effects work when viewed at 100 percent.

» Early videogames required graphics that used as few colors as possible. One way to get around this limitation was to use dithering, a chequerboard of lighter and darker pixels that blends together to look like a single, mid-toned color. Give it a try. You can create an interesting texture if the two colors are quite different (**Image I**).

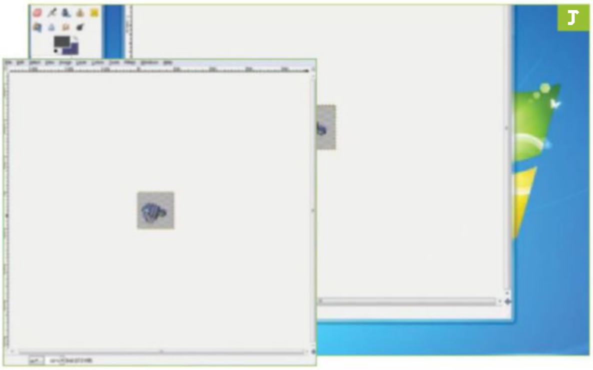
5 EXPORTING AND USING YOUR ART

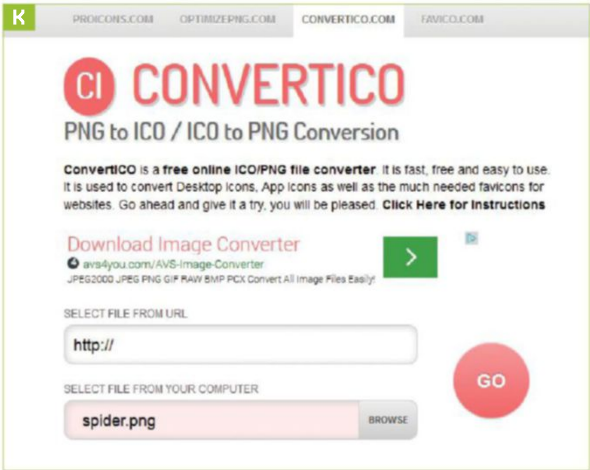
Once you're happy, click on the "Grid" and "Background" layers in the right-hand palette and delete them. Now click "File → Export as." You want to keep the transparent background, which means saving it in PNG or GIF format (**Image J**). Don't choose JPG; this format doesn't support transparency and the compression will make everything blurry.

» Select a file type from the drop-down list and give it a name. At the next dialog box, uncheck "Save Background Color" and "Save color values from transparent pixels," then click "Export." Your finished pixel art will now be saved with a transparent background, ready for use in a game, as an icon on your desktop, or on a web page.

» One of the easiest ways to use your pixel art is to convert it into an ICO file and use it to replace one of the program icons on your desktop (**Image K**). You can do this using a website called ConvertICO (www.convertico.com). Simply browse for the PNG or GIF file, click the "Go" button and it will be converted.

» You'll see a preview of your icon. Click the large arrow and download the icon to a convenient place. Now go to your Windows desktop, right-click an icon and select "Properties." Click "Change Icon," browse to your newly made ICO file and click "OK" (**Image L**). Finally, click "Apply" and enjoy!


J


K

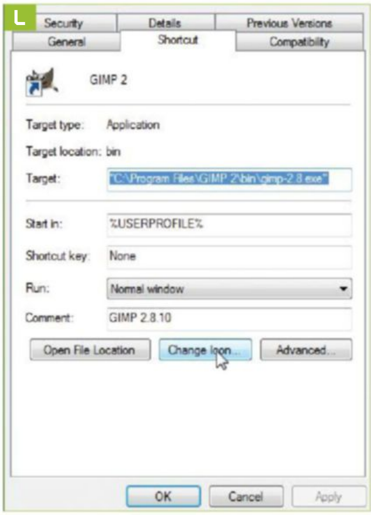
PNG to ICO / ICO to PNG Conversion

ConvertICO is a **free online ICO/PNG file converter**. It is fast, free and easy to use. It is used to convert Desktop Icons, App Icons as well as the much needed favicons for websites. Go ahead and give it a try, you will be pleased. **Click Here for Instructions**

Download Image Converter
avs4you.com/AVS-Image-Converter
JPEG2000 JPEG PNG GIF RAW BMP PCX Convert All Image Files Easily!

SELECT FILE FROM URL: http://

SELECT FILE FROM YOUR COMPUTER: spider.png


L

GIMP 2

Target type: Application

Target location: bin

Target: "C:\Program Files\GIMP 2\bin\gimp-2.8.exe"

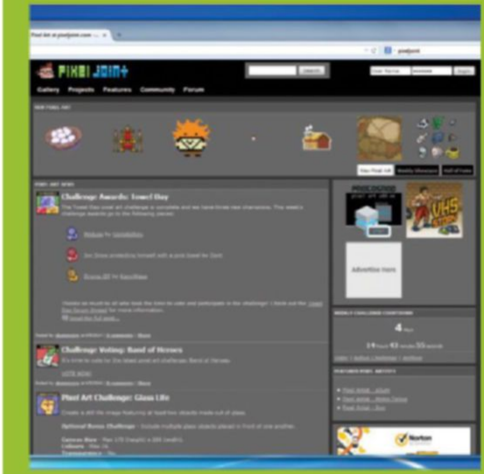
Start in: %USERPROFILE%

Shortcut key: None

Run: Normal window

Comment: GIMP 2.8.10

TAKE YOUR PIXEL ART FURTHER


Pixel Joint is just one of the online communities for sharing art and getting feedback.

Creating good pixel art takes time and practice, but there are lots of online communities where you can ask for advice on works in progress and display your finished creations for constructive feedback. One of the most well respected is Pixel Joint (www.pixeljoint.com), where weekly challenges are also posted to inspire artists. The site's users vote for their favorite entries each week, and the top three receive an award. There are also interviews with artists that offer an insight into their process (http://bit.ly/1l1kZPH), plus a range of handy tutorials (http://bit.ly/1s5T6tD).

Another great place for advice and inspiration is DeviantArt—a huge art site that's part gallery, part social network, and great for getting your work seen. To browse the site's pixel art gallery, visit http://bit.ly/1CV10c5. Use the menu on the left to select different categories, including characters, objects, and scenes. You'll also come across various groups dedicated to the style. Anyone can register for a free account with DeviantArt, and additional features are available for a subscription fee.

Whichever community you join, remember never to share illustrations created using tools such as Blur, Airbush, and Gradient, and always save your work in PNG or GIF format. If you want to share your pixel art on a forum, upload it to an image hosting site such as Imgur (www.imgur.com), and paste the section of code under the heading "BBCode" into your post.

Speed Up Your PC in Five Minutes

YOU'LL NEED THIS

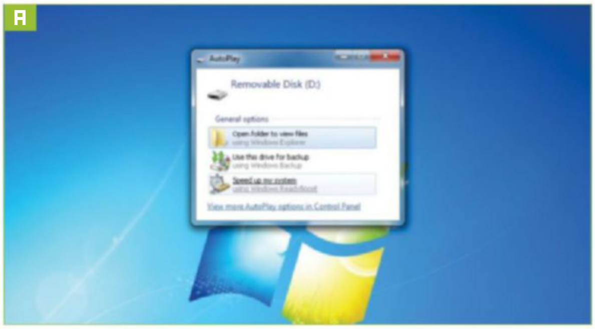
FLASH STORAGE
An SD card or USB stick.

THERE ARE FEW THINGS MORE FRUSTRATING than realizing your once speedy computer is feeling slow. But don't worry—there's no need to upgrade yet, as Windows offers an easy solution. ReadyBoost is a built-in tool that uses removable flash memory, such as USB sticks, to cache some files to speed up your system. In Windows 7 and 8, the amount of memory that can be used has been greatly increased, and you can now use more than one form of removable memory. It's particularly useful for systems running with less than 2GB of RAM, such as netbooks. –**DAN GRABHAM**

1 INSERT AND CHOOSE READYBOOST

Once the AutoPlay window pops up, you can start using ReadyBoost. The relevant option is at the bottom of the list (**Image A**), where you'd normally choose to browse the device or load images from an SD card into Windows Live Photo Gallery. When you click "Readyboost," you'll be taken straight to a configuration screen.

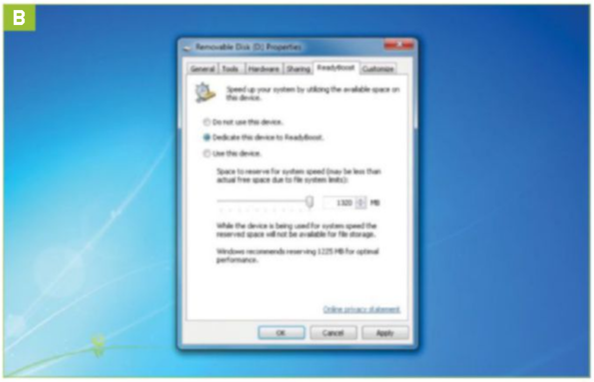
A


AutoPlay
Removable Disk (D:)
General options
Open folder to view files
Use this drive for backup
Speed up my system

2 CREATE A DEDICATED SERVICE

If you only intend to use this USB flash drive for ReadyBoost and don't plan to store any data on it as well, you should turn it into a dedicated device. To do this, simply check the second option in the list, "Dedicate this device to ReadyBoost" (**Image B**). This option makes all of the USB drive's storage space available to be used by Windows.

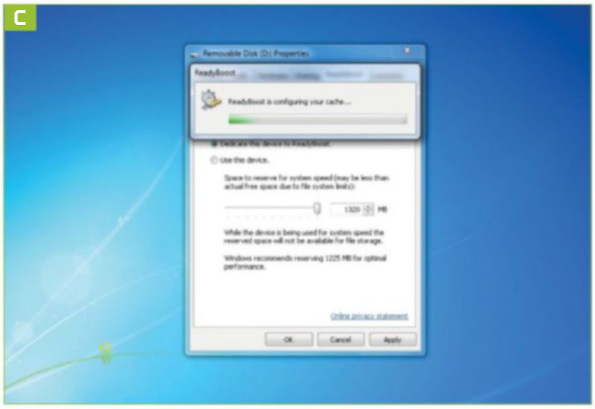
B


Removable Disk (D:) Properties
General
Tools
Hardware
Sharing
ReadyBoost
Customize
Do not use this device.
Dedicate this device to ReadyBoost.
Use this device.
MB
Online privacy statement
OK
Cancel
Apply

3 PREPARE IT FOR USE

Now that your USB stick is a dedicated device, it's ready to give your computer the performance boost it so badly needs. Click "OK" and your device is prepared for use by the system (**Image C**). From now on, whenever you insert that drive into your PC, Windows recognizes it as a ReadyBoost device and speeds up your system.

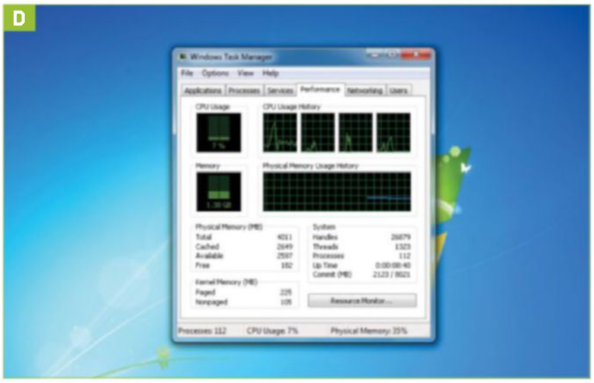
C


Removable Disk (D:) Properties
ReadyBoost
Use this device.
OK
Cancel
Apply

4 ENJOY!

You should now have a noticeably more responsive PC (**Image D**). ReadyBoost won't help you transform a basic machine into a gaming behemoth, but you should feel a real change in your system's performance, and it might even help you stave off the need for a new computer for a little while. ⏻

D


Windows Task Manager
File
Options
View
Help
Applications
Processes
Services
Performance
Networking
Users
CPU Usage
CPU Usage History
Memory
Physical Memory Usage History
Resource Monitor...

BUILD IT

TOM MCNAMARA **TECHNICAL EDITOR**

Hybrid Theory: Big Capacity, Small Box

LENGTH OF TIME: **1–2 HOURS** LEVEL OF DIFFICULTY: **LOW**

Can we combine compact size, high performance, and loads of storage? We'll give it a shot

THE MISSION

IF YOU COULDN'T TELL BY NOW, we're performance junkies here at *Maximum PC*. Just three months ago, we were crazy enough to build a $30,000 liquid-cooled computer with two PCs inside it. But you can't drive in the fast lane all of the time. Sometimes it's better to take a quiet Sunday drive down to the park and have a picnic. That doesn't mean the meal has to be bland, but we will be shifting gears for a new palate (with a side of mixed metaphors).

This month, instead of building for just speed, we're also building for capacity. But that's a pretty straightforward challenge; anyone can slap a bunch of hard drives in a case and call it a day. We're going to up the ante by shoving eight hard drives into a mini-ITX case. At least, that was the original plan before motherboard maladies intruded. Whatever, we like having massive storage options in addition to our turbo-charged gaming PC or A/V production workstation. This way, we can create a library of full-system backups, and stream media to devices, in a discreet and portable form factor.

ROCKING OUT

IF YOU WANT TO CRAM a large number of drives into a mini-ITX system, special gear is required. We were originally going to go with the Asrock C2550D4I, which has 12 SATA ports and an integrated low-power Avoton quad-core CPU, and support for ECC RAM. Unfortunately, we discovered it's quite finicky about what RAM it will accept, and appears to strictly adhere to modules on the qualified vendor list. After many failed boot attempts and different slot configs and half a dozen DIMMs, we had to give up. It's not just us either, the Internet is rife with people reporting similar problems.

So, we had to switch to Plan B: a conventional Intel Z97 motherboard and Haswell CPU. This cuts our maximum drive count to four, but we could always install a RAID card in the PCIe slot to add more if we wanted. You can also remove a part of the 3.5-inch drive cage to make room for a long card, though this does sacrifice one drive tray.

But what kind of mini-ITX case could even hold eight 3.5-inch drives? Enter the SilverStone DS380, whose entire front is a series of drive bays measuring about 11-inches tall. It's also over 8-inches wide, giving us room for a variety of activities. This case also takes SFF (small form factor) power supplies, and we went with the SilverStone ST45SF-G, a bronze-rated unit pumping out up to 450 watts.

INGREDIENTS

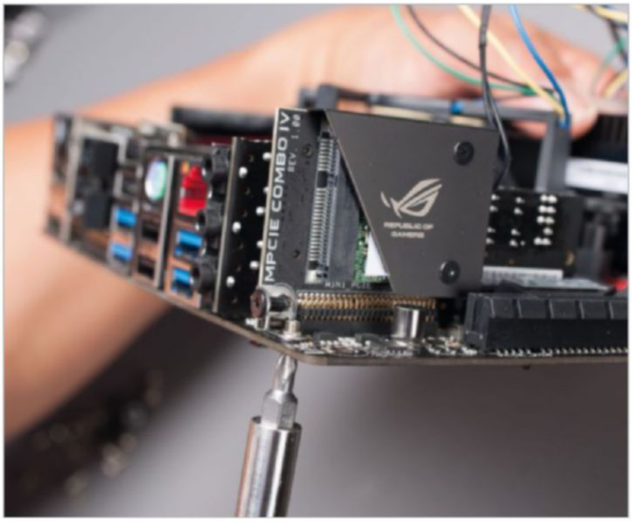
	PART	PRICE
Case	SilverStone DS380	$150
PSU	SilverStone ST45SF-G 450W	$95
Mobo	Asus ROG Maximus VII Impact	$220
CPU	Intel Core i7-4790K	$340
GPU	Nvidia GeForce GTX 780	$430
RAM	2x 8GB Corsair Dominator Platinum	$210
HDD	3x 6TB HGST Ultrastar He6	$1,440
SSD	1TB Samsung 850 Pro	$700
Cable Kit	SilverStone PP05-E	$30
OS	Windows 8.1 Pro	$135
Total		$3,750

1

STEP ON BOARD

OUR REPLACEMENT MOTHERBOARD is the Asus ROG Maximus VII Impact. Compared to Plan A, this one has a full x16 slot, USB 3.0, shielded integrated sound, dual-band 802.11ac, and of course, a spot to install a Haswell CPU. (We went with an unlocked model because we didn't have the locked version handy and this board with a locked CPU would be a crime.) You have to install a couple of modules on the board such as the Wi-Fi.

Our max RAM capacity is reduced to 32GB, and we lose eight SATA ports and one fan header. You can install a RAID card to add more SATA ports, instead of the video card, but we wanted a hybrid build. By way of compromise, we slapped in three 6TB hard drives and one high-powered 1TB solid-state drive.



2

GETTING CAGEY

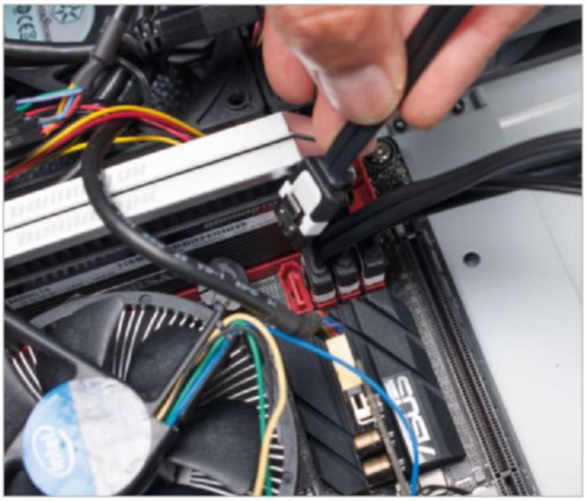
THIS IS A COMPACT CASE, so we need to temporarily remove both drive cages to give the board enough clearance for installation. The main drive cage in the front is secured with four small black screws on the side, and two chromed screws underneath the case. Once those are removed, you can slide the drive cage toward the rear, and lift it right out. Then, the 2.5-inch drive cage at the top of the case comes out.

The motherboard has a vertical extension that holds additional voltage regulators, which is attached via two screws. Remove these, line the board's four corner holes up with the pre-installed standoffs in the case, and screw in the board.

3

ALL WIRED UP

WITH THE BOARD INSTALLED, we can begin hooking it up. We attach all four SATA cables now, since they're easy to reach with the drive cage removed. The Impact's audio comes in though a daughterboard. We plug that in, screw it down, and connect the front-panel audio cable to it. There's an additional mini-card to add two fan headers, and another for Wi-Fi. The I/O shield has perforated holes that you tap out and send the Wi-Fi connectors through.



4

BY THE POWER SUPPLY OF GREYSKULL

SINCE WE HAVE the case open, now is a good time to install the power supply. It goes in the top, and there's an intake grill right there for the PSU to get cool exterior air. We take the flat-cable kit and connect the motherboard power, CPU power, SATA power, and Molex. Our hard drives will be getting their power from the PSU's Molex cables; both of them plug into the drive cage's backplane and provide all the juice needed there. We'd never find an SFF PSU with eight SATA connectors anyway (this one has two).

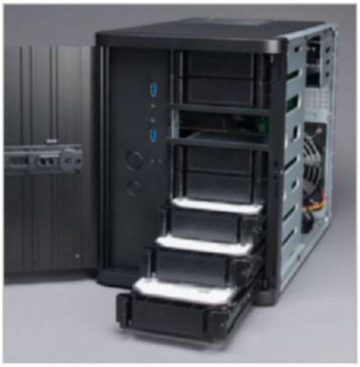
The motherboard power cable is a bit tricky to plug into the board because it's nearly flush with the bottom of the case, but we managed to wiggle it in after a few tries. The CPU cable also has one end specifically for the PSU and another for the mobo.

5

PIECING IT TOGETHER

WITH THE MOTHERBOARD hooked up, we can drop the drive cages back in. Note that the backplane of the 3.5-inch cage has two data connectors per drive. One is actually for dual-channel SAS drives, while the other is for SATA or single-channel SAS. (They're clearly labeled to avoid confusion).

We take the other ends of those SATA cables we plugged into the motherboard earlier, and we attach them to the SATA side of the backplane, one by one. Then we put the cage's screws back in and unlock the door, which uses a five-sided bit as a key. With the door open, the drive trays slide out from the front. Since the backplane has integrated SATA/SAS connectors, you just put the drive into the tray, attach a few screws, and slide the tray back in. The drive is now installed.



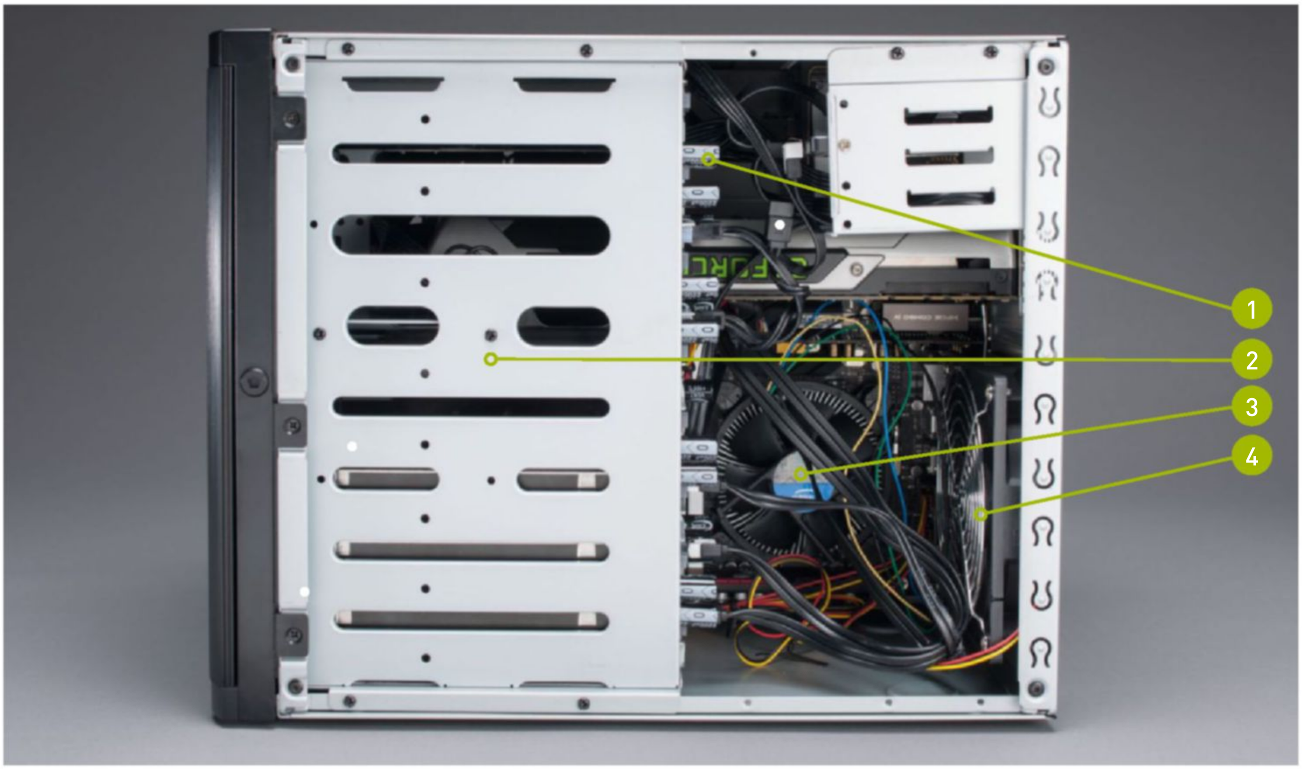
Although we can't populate the whole cage with drives, three 6TB units give us 18TB, which is a very good start. Plus there's the 1TB on the SSD, which we're using to boot Windows. If only we had 10TB drives!

6

IN PLANE SIGHT

SINCE THE SATA PORTS on the board are close to the backplane, we can tuck most of the SATA cabling behind the cage. All three fans have twist ties pre-attached, so they need minimal adjustment. The rear fan cable is a bit tricky, though. Its cable is not sheathed, so the wires are easily snagged. You can tuck away the wires, as there isn't a fan header particularly close by. You also want to keep it well clear of the CPU's heatsink, to keep the wire insulation intact. We ended up just stringing it along the bottom of the case. It's not pretty, but it gets the job done.

The other cables are mostly hidden by the sheer bulk of the 3.5-inch drive cage (which would weigh over 15 pounds after populating all eight trays). This is not a flashy case with a side window, but you're unlikely to be fiddling with its innards often, so appearance is not a high priority.



1. These funny-looking cylinders are capacitors that help provide power to the storage devices in the 3.5-inch drive cage.

2. With 8TB 3.5-inch drives on the way, this eight-tray cage could hold 64TB of data—plus the four-drive 2.5-inch cage.

3. We wanted to add a third-party CPU cooler for overclocking, but the space here is just a little too tight.

4. We added a grill to the rear fan, since there's a non-trivial amount of wiring hanging around the area, even after tidying up.

FANCY TOYS BRING HIGH PRICE AND MIXED RESULTS

IRONICALLY, WE STARTED with the Asrock C2550D4I because we wanted a more straightforward build. With an integrated CPU and cooler, it cut down on the steps we needed, giving us more time to fiddle with Ubuntu (the CPU on the original board doesn't support desktop versions of Windows, and we couldn't justify $700 Server 2012). It's been a while since we gave desktop Linux a spin, but that'll have to wait.

As far as we can tell, the C2550D4I is picky as hell with RAM. Asrock has a very short QVL list for RAM and many of them aren't sold in the United States. After burning hours trying to get the board to POST with a fistful of different modules in every possible configuration, we gave up. But rather than completely bail, we decided to make something of the system, especially since we had some nice hardware waiting in the wings.

Almost no video card would be possible without the removable section on the 3.5-inch drive cage. Not even that shorty Nvidia GeForce GTX 760 that we used in one of the *Minecraft* builds last month. Even then, the dimensions of the cut-out clearly limit you to a reference-sized card—we ended up with only a few millimeters between the card and the edges of the cage. Luckily, we have several reference units lying around (and we made sure we chose one you could still buy).

PROBLEM FANS

The other half of the equation was SilverStone's cable kit, which is short and flexible. At $30, it's not a cheap kit, but with over $3,700 already invested, it's a relatively small expense. You could try using your own cable set, but, for safety reasons, we don't recommend it. Each power supply's set of cabling is designed for a specific range of tolerances. Our original power supply was 300 watts and had integrated cables, but only one PCIe connector. We needed two for the GTX 780.

We almost fit a Cooler Master 212 EVO on top of the CPU, but the capacitors on the drive cage's backplane poke into that space. Putting the fan on the other side of the radiator fin stack would also compel us to reverse the airflow of the rear exhaust fan, or else the rear exhaust and CPU fan would be fighting over the air coming their way. There would be no proper exhaust for the case, and heat would build up. We could've experimented with a 120mm closed-loop water cooler, but the build was already in overtime.

We'd consider this build a qualified success but we honestly don't recommend anyone follow our blueprint. It would have been cool to slap a load of high-capacity drives in there and see what the Asrock CPU-plus-mobo combo could handle. At $280, the C2550D4I would also have been considerably cheaper. On the bright side, we get more adaptability with the higher cost and desktop OS driver support. But our price tag is on the high side. You'd probably be fine with an Intel Core i5 CPU, $125-ish mobo, 8GB of RAM, and 250GB SSD. That slashes about $1,000 off the build. Then you can go with much less expensive 4TB or 3TB drives. But like we said, why let the fancy toys collect dust? ⏻

Say hello to the X-10

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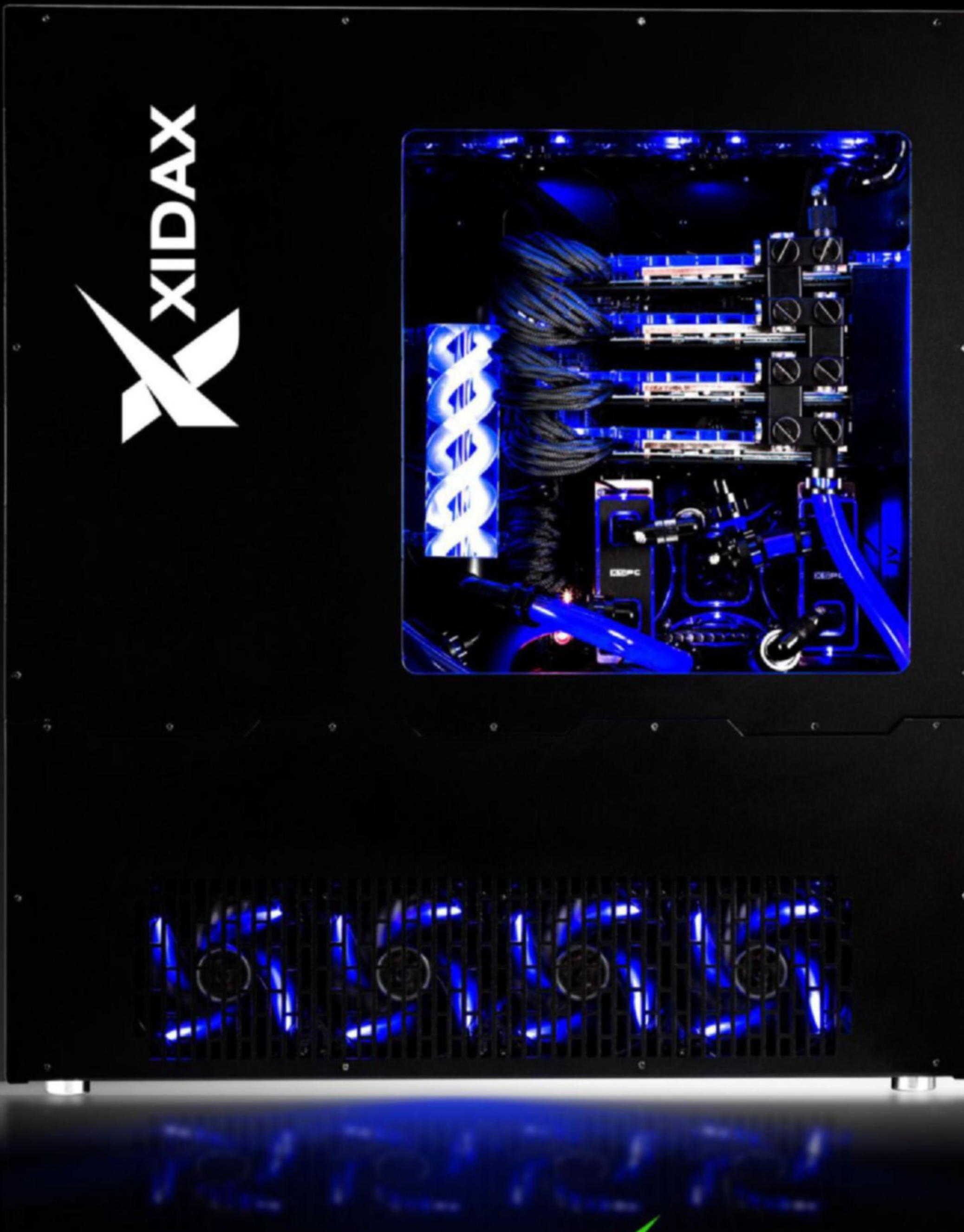

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TESTED. REVIEWED. VERDICTIZED.

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POLYWELL MINIBOX X9900X
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ECS LIVA

Tons of value, acceptable performance

HAVE YOU EVER FIRED UP your Quarter Pounder–sized (Royale with Cheese for our readers in the Netherlands) Intel NUC and thought to yourself: "Damn, this thing is too big"? Probably not. What you probably *have* thought, though, when Windows shopping the eStore, was: "This thing is too damned expensive!"

After all, you just want a low-power, quiet UCFF (ultra compact form factor, aka micro-PC), to knock around with on your big-screen TV. That, my friend, is where ECS's new LIVA PC kit comes in. The LIVA breaks new price boundaries and practically crosses into the impulse-buy category of computing. You may think $147 isn't that cheap, but you should know the price includes 32GB of soldered-on eMMC storage, a WiFi and Bluetooth 4.0 module, plus 2GB of soldered-on RAM. And when we say kit, we mean kit. You have to snap in the wireless card and antennas, and drop the mobo into the chassis. The good news is that it will take you less than five minutes. We guess that saves ECS another two bucks in labor.

No NUC from Intel even approaches the same value, as you have to bring your own storage and RAM, making them considerably more expensive. Intel's cheapest NUC, the sexily named DE3815TYKHE, packs a single-core 1.46GHz Atom E3815 CPU and sells for $130. That cost, however, includes neither RAM nor wireless support. You'll also have to add in a standard 2.5-inch SATA drive if you want to get beyond the unit's pathetic integrated 4GB eMMC drive for storage.

But enough on price, you probably already know how it actually stacks up in specs. To get to $147 with storage and RAM, you shouldn't expect a Core i7-4770R inside. Instead, ECS eschews the Haswell microarchitecture completely for a dual-core 1.58GHz Celeron N2930 "Bay Trail-M" SOC part. Yes, it's a very close cousin to the Atom parts used in Windows 8 tablets, but remember, these are the newer Atom processors that shouldn't be confused with their slack-jawed, dim-witted, alleged CPUs from a generation ago. No, these Silvermont-derivative CPUs run a full OS with a surprising amount of responsiveness for those expecting an Atom.

CHEAP AND CHEERFUL

The use of the SOC isn't just about cost, either. It's also about thermals. All of the UCFFs we've seen have been actively cooled. The LIVA is fanless and ghostly silent under all loads. There have been reports of the LIVA getting scorching hot in reviews, but we didn't see anything abnormal under stress testing.

The most important question for some will be performance. For comparison, we threw it against a spate of NUC and Brix units we've reviewed. The results aren't pretty, albeit not as bad as we thought it would be. Before anyone goes on a performance rant, let's also remember that the LIVA is far cheaper than any of the units it's being compared to. The Haswell NUC, for example, would easily set you back almost $500 when built—that's $353 more than the LIVA.

So it won't win any races, but maybe the more important question is what can you do with it. If your intentions are basic office drone functionality and to browse the Internet, it'll work. Even 1080p YouTube and Netflix streaming is adequate. There are occasional hiccups and slowdowns you won't see with more muscular UCFFs but it's generally fine, especially when you consider the price. Maybe the category the LIVA should really be placed in is the Raspberry Pi crowd. A Raspberry Pi Model B with 512MB of RAM will set you back $40 but you have to add storage, a power supply, chassis, and Wi-Fi dongle, which could tack on another $35. And next to the performance of the Raspberry Pi, the Celeron N2930 is practically a super computer.

Our main knocks against the LIVA are the lack of USB ports. It has just two, which makes installation of the OS a pain. The integrated eMMC is also slow with reads of 107MB/s and writes at just 41GB/s. That's practically HDD speed but at least you get minimum access times.

In the end, the LIVA is a surprisingly satisfying little project computer that gets you acceptable general use performance for very little cash. Just don't expect the world of this little tyke and you can have a lot of fun with it. **–GORDON MAH UNG**

BENCHMARKS

	ECS LIVA	Intel NUC DC3217IYE	Intel NUC D54250WYK	Gigabyte Brix Pro
CPU	1.58GHz Intel Celeron N2807	1.8GHz Intel Core i3-3217U	1.3GHz Intel Core i5-4250U	3.2GHz Intel Core i7-4770R
Graphics	HD Graphics	HD4000	HD5000	Iris Pro 5200
Stitch.Efx (sec)	4,790	2,453	1,747	867
ProShow Producer (sec)	7,075	3,729	2,567	1,410
3DMark Cloud Gate	1,127	3,409	3,958	10,406
3DMark Ice Storm	14,011	35,969	32,157	68,195
Google Octane 2.0	7,129	10,643	17,832	26,893
Idle Power Consumption	3	8	5	8
Power Consumption Prime95+Furmark (watts)	11	35	24	87
Power Consumption YouTube 1080p (watts)	8	14.5	19	20

VERDICT

8

ECS LIVA 32GB

+ IN A GADDA DA VIDA Inexpensive; small; sips power.

– LIVIN' LA VIDA LOCA Slightly underpowered; not enough storage.

$147, www.ecs.com.tw

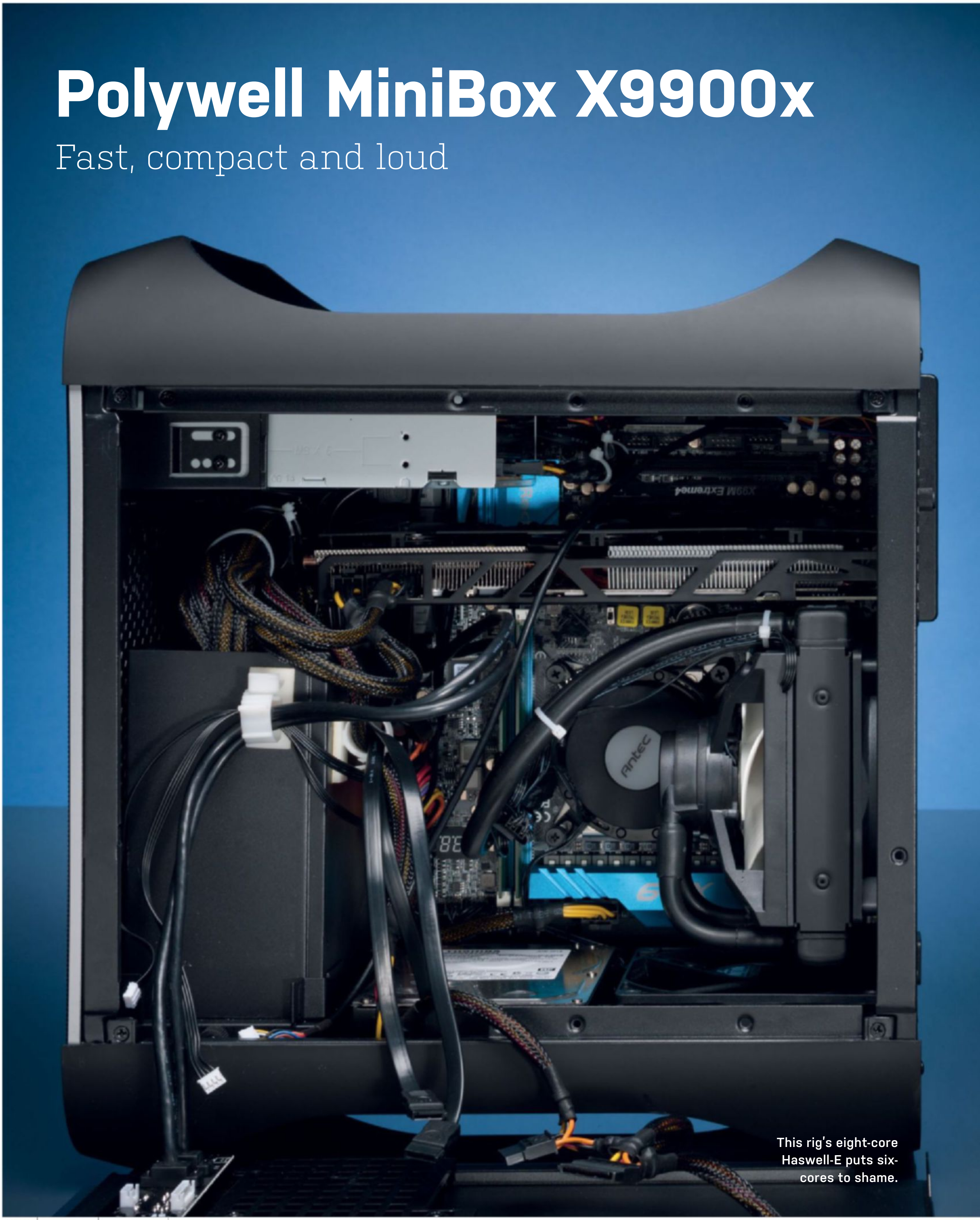
SPECIFICATIONS

CPU	Intel Celeron N2930
RAM	2GB DDR3L
GPU	Intel HD Graphics
Storage	32GB eMMC
Ports	1x USB 2.0, 1x USB 3.0, VGA, HDMI, Gigabit Ethernet, micro-USB power
Dimensions H x D x W	2.25 x 2.75 x 4.5 inches

The LIVA is so energy-efficient you can run it on a phone-charger battery (the coins are for size reference, not how cheap it is).

Polywell MiniBox X9900x

Fast, compact and loud


Antec
X99M Extreme4

This rig's eight-core Haswell-E puts six-cores to shame.

AS BOTH CERTIFIED performance enthusiasts and smaller-PC fetishists, we wondered how long it would take to get Intel's new eight-core hotness, the Haswell-E, in a tiny case. While Polywell's MiniBox X9900x doesn't exactly qualify as "tiny," it's probably as small as you're going to see with Intel's Core i7-5960X powering it. With the hefty size of the LGA2011-v3, it'll probably never make its way into a mini-ITX mobo.

Full details of the parts used in this box are below, but the highlights include the eight-core Core i7-5960X chip. The chip normally runs a stock 3GHz with a boost of 3.5GHz on one core. The MiniBox Polywell does a decent overclock to 4.2GHz. This can't be done with air cooling; it's up to the Antec closed-loop cooler to keep it from melting the case to the ground. For a foundation, Polywell plugs the Hassy-E into an Asrock X99m-Extreme4 mobo and pairs it with 16GB of Crucial DDR4/2133 RAM. Graphics are handled by a single Gigabyte Windforce Radeon R9 290X. The PSU running all of this is a de-branded 750-watt 80+ bronze unit. Why Polywell decided to de-brand the PSU, we're not sure.

Of course, you don't care about any of this—all you want to know is how it performs. As this is the first formal sighting of a Haswell-E in a pre-built PC, we all want to see how it struts its stuff. Wait no longer. The Polywell MiniBox X9900x with its Haswell-E doesn't disappoint in CPU performance. First, the good news. In multi-threaded tasks, it smokes all before it. Our six-core Sandy Bridge-E box overclocked to 3.8GHz? Feh. Dream Machine 2013? Smoked. Dream Machine 2014? Toast. $12,000 rig with CPUs overclocked until they were given last rites? RIP. There's so much smoking of all before it that we're surprised the FDA didn't slap a health warning on the MiniBox X9900x. And we don't mean by 2 or 5 percent either. The MiniBox X9900x finishes our Premiere Pro benchmark 62 percent faster; in x264 HD 5.0 it moves up to 67 percent. The record holder had been a Digital Storm Ivy Bridge-E box OC'ed to 4.7GHz. Not anymore. The Polywell MiniBox X9900x sprints past the DStorm by up to 29 percent in Premiere. That same Aventum II also held the record in X264 HD 5.0, but the MiniBox X9900x encodes video roughly 31 percent faster than that big-ass tower.

NOBODY'S PERFECT

The world is not all multi-threaded, though. In tasks that can't use all those cores, high clock speed (and microarchitecture, of course) matters more than core count. Even there, the MiniBox doesn't disappoint. It easily eats our zero-point by a hefty 21 percent in both Stitch.Efx 2.0 and ProShow Producer 5.0. Against the Haswell Core i7-4790K in Dream Machine 2014 running at 4.7GHz, the MiniBox is only 2 percent slower in Stitch.Efx 2.0 and 4 percent in ProShow Producer 5.0. Yes, all this from a small form factor box.

Where the MiniBox can't hang is in gaming. With its single Radeon R9 290X, it's not going to beat multi-card systems. But we'll note that size isn't everything. For kicks, we ran the numbers against the Falcon Northwest Tiki-Z we reviewed in September. With its single Titan Z card (essentially two down-clocked Titan Black cards) the Tiki-Z offers roughly twice the gaming performance of the MiniBox. To be fair, the MiniBox pays back in CPU benchmarks, too.

If it sounds like the MiniBox is cruising for an easy victory, it is. Except for one problem: It's loud. The Gigabyte Windforce cards are typically very quiet under load but when pushed here, all three fans spooled up and become quite noticeable. The Antec Kuhler H20 650 cooling the CPU also gets noticeable under CPU loads. It's not as annoying as the GPU but you can tell this may be just a little too much hardware for this system. One solution would be to add more fans to move the heat out of the case, which might tone down the GPU. The Prodigy case's internal layout makes this tough, but we think Polywell could have added more fans.

This does color our view of the MiniBox, but how much should the noise dock the score? That one's hard to say. While the noise is bad in gaming (although we've heard worse), CPU loads aren't that bad. And then there's the price. At $2,900, there's a lot of performance per buck in the MiniBox. Plain? Yes. Loud at times? Affirmative. Stupidly fast in CPU chores? Hell, yes. **–GORDON MAH UNG**

VERDICT
8

Polywell MiniBox X9900x

+ POLYHEDRON Demolishes multi-threaded benchmarks; almost affordable.

– SQUARE Loud; not much panache.

$2,899; www.polywell.com

BENCHMARKS

	ZERO-POINT	TESTED SYSTEM
Premiere Pro CS6 (sec)	2,000	1,232
Stitch.Efx 2.0 (sec)	831	686
ProShow Producer 5.0 (sec)	1,446	1,196
x264 HD 5.0 (fps)	21.1	35.3
Batman: Arkham City (fps)	76	77
3DMark 11	5,847	4,771 (-18%)

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Our current desktop test bed consists of a hexa-core 3.2GHz Core i7-3930K overclocked to 3.8GHz, 8GB of Corsair DDR3/1600, on an Asus Sabertooth X79 motherboard. We're running a GeForce GTX 690, an OCZ Vertex 3 SSD, and 64-bit Windows 7 Professional.

SPECIFICATIONS

CPU	Intel 3GHz Core i7-5960X (4.2GHz overclock)
Mobo	Asrock X99m-Extreme4
RAM	16GB Crucial DDR4/2133
GPU	Gigabyte R9 290X Windforce 3X
Storage	2x 128GB Samsung 840 Pro SSD in RAID 0; 1x Toshiba 2TB HDD
Optical Drive	LG Blu-ray burner
Case/PSU	Bitfenix Prodigy / 750 watt 80+ bronze-rated PSU

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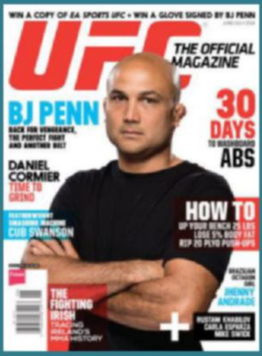
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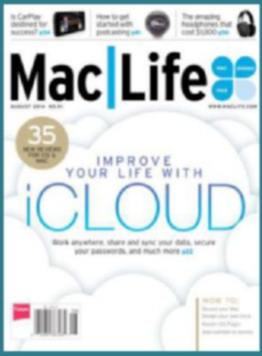
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AMD Radeon R7 240GB

The CPU and GPU maker expands to SSDs

There's no 1TB SKU; just 120GB, 240GB, and 480GB.

AMD
RADEON
SOLID STATE
DRIVES

THE MARKET FOR SOLID-STATE STORAGE has gotten pretty crowded, and most SSDs can use up all available bandwidth on the SATA III bus. With SATA Express and M.2 devices emerging, the transition away from older, slower technology is in full swing. Despite this, AMD is expanding its Radeon brand from video cards and RAM sticks to SSDs. But the R7 is not the company's own tech, so its investment is much lower than usual.

This line (available in 120GB, 240GB, and 480GB sizes) is the product of OCZ Storage Technology, which Toshiba bought this year. The unit is very similar to OCZ's Vector 150, but with a lower-clocked Barefoot 3 controller chip, and a more up-to-date set of NAND memory. The Radeon SSD also has a four-year warranty, one more than standard. Like the Vector 150, it has hardware-accelerated 256-bit AES encryption and ships with a 3.5-inch drive bay adapter and download code for Acronis True Image HD, a popular tool for creating backups and managing drive partitions.

Looking at performance, we see results similar to the OCZ Vertex 460, which also uses the Barefoot 3 controller. Neither drive fully saturated the SATA III bus in our tests, but the R7 SSD also fares oddly in the ATTO benchmark. At the 64KB file size, it's reading and writing at about 400MB/s. We usually see numbers closer to 500MB/s. At the 128KB tier and above, the drive shoots up to the normal range of 525–550MB/s. If you're moving a lot of image files, the performance gap will become apparent.

But as a boot drive, the sheer access time of SSD technology matters more, and the Radeon R7 does fine there. Plus it's possible to fix some performance quirks with a firmware update. You'll be able to use the OCZ Toolbox software for updates and secure erases. It doesn't come with the drive, but you can easily download it.

MONEY MATTERS

Transfer speeds aren't as high as we'd hoped, given the $160 MSRP. OCZ's Vertex 460 has a street price of $125 and also bundles True Image HD, though its warranty is only three years. Then there's the Crucial MX100, a popular competitor at $110. So a lot of the R7's appeal depends on where the street price lands, and how much you want True Image HD. Since 2012's original Vector, OCZ hasn't been known for aggressive pricing, but new ownership and a collaboration with AMD could spell change.

We're more confident about its warranty, with its "ShieldPlus" support. You can use the drive's serial number, instead of a receipt, and OCZ claims it will replace it with a brand-new unit (rather than refurbished products). It'll provide shipping labels and it'll do "advanced product placement," meaning it will ship you a new SSD before it's received your old one. It looks like OCZ and AMD are eager to please. If they stick to a support plan of this caliber, it can increase their appeal in a highly competitive sector. Samsung has shown that people are willing to pay a premium for high-quality SSDs. –MAXIMUM PC STAFF

BENCHMARKS

	AMD Radeon R7	SanDisk Extreme Pro	Crucial M550	Samsung 840 Pro	OCZ Vertex 460
Controller	Barefoot 3	Marvell	Marvell	Samsung	Barefoot 3
Capacity	240GB	480GB	1TB	256GB	240GB
Warranty	4 years	10 years	3 years	5 years	3 years
CrystalDiskMark					
Avg. Sustained Read (MB/s)	449	**531**	501	517	489
Avg. Sustained Write (MB/s)	500	**503**	482	498	488
AS SSD – Compressed Data					
Avg. Sustained Read (MB/s)	502	**514**	**514**	DNT	503
Avg. Sustained Write (MB/s)	490	486	478	DNT	**491**
ATTO 4QD					
64KB File Read (MB/s)	320	474	466	517	**519**
64KB File Write (MB/s, 4QD)	398	524	470	**545**	479
Iometer IOPS					
4KB Random Write 32QD (IOPS)	72,501	44,334	**84,748**	49,238	65,242
PCMark Vantage x64	47,871	47,055	**76,251**	68,160	72,435
Sony Vegas Pro 9 Write (sec)	279	**272**	315	421	323

Best scores are bolded. All tests are conducted on our hard drive test bench, which consists of a Gigabyte Z77X-UP4 motherboard, Intel Core i5-3470 3.2GHz CPU, 8GB of RAM, Intel 520 Series SSD, and a Cooler Master 450W power supply.

VERDICT 8

AMD Radeon R7 240GB

ROADRUNNER Very good performance; high-grade support.

ROADKILL Difficult price point; some quirky test results.

$160, www.amd.com

Amped Wireless REC15A

Take your router to new heights

IN AN IDEAL WORLD, routers would offer the perfect amount of Wi-Fi coverage, but the truth is even the best routers have their limits. If you've got a big house, or live in an area with thick walls and have multiple dead spots, things can get hairy. This is where Wi-Fi range extenders come into play, and Amped Wireless is promising to fill that wireless void with its REC15A.

This $100 device attempts to duplicate and extend the range of any 802.11a/b/g/n/ac Wi-Fi network, be it a 2.4GHz or 5GHz connection. The idea is for you to place the extender in the path between your router and where your Wi-Fi signal cuts off.

The device itself is fairly small, measuring 5x3x1-inches, and has a removable antenna. Inside of the little white box are four "amplifiers"—two deliver the 2.4GHz signal and the other two handle the 5GHz connection. The REC15A uses 500mW of power, which Amped says allows the device to cover up to 5,000 square feet. If that weren't enough, the device also has an Ethernet jack, for those who prefer the wired route.

BENCHMARKS

	Amped REC15A	Asus RT-N66U
Living Room ping (ms)	322	11
Living Room download speed (MB/s)	1.8	18.3
Living Room upload speed (MB/s)	0.8	3.2
Bathroom ping (ms)	285	11
Bathroom download speed (MB/s)	3.6	18.3
Bathroom upload speed (MB/s)	0.8	2.6
Basement ping (ms)	15	No signal
Basement download speed (Mbps)	4.8	No signal
Basement upload speed (Mbps	2	No signal

The REC15A also has some handy software tools, such as Amped Wireless's Wi-Fi Analytics app. It's not always 100 percent accurate, but the idea is you can use your smartphone or tablet to view your signal strength as you move around your house. There's also a separate web client that allows you to limit how far your Wi-Fi range extender reaches. You can also do things like set time of operation, and create up to eight guest networks with unique passwords and bandwidth limitations.

Installing the device is pretty simple. After plugging it into a wall socket, you connect your wireless device to the range extender's Wi-Fi network, enter in a setup URL, scan for the wireless network you're trying to expand, and you're set. It's a relatively painless affair. We weren't completely satisfied with the range extender's performance, however.

SEARCHING FOR A SIGNAL

We used an Asus RT-N66U router along with an Acer S7 Ultrabook. Rather than pure LAN performance, we wanted to test that all-important factor: Internet access from far-flung areas of our house, so we used Speedtest.net across our cable ISP.

We tested out a variety of scenarios. First, in the living room right next to our router and approximately 25 feet from our range extender, which was connected in a restroom down the hall. Here, the router blew away the range extender, getting about 1/30th the ping, 10x download speed, and about 3.5x upload speed. As we moved into the restroom with the REC15A, the range extender did a little better. The router took a small hit, but the REC15A's ping dropped to 285ms and the download speed doubled to a respectable 3.6MB/s. Where its real usefulness came into play, however, was when we moved into the basement, about 25 feet from the range extender and about 50 feet from our router. The distance proved too much for our router to handle; the laptop wasn't getting a strong enough signal to connect. The range extender, oddly enough, reported its healthiest scores: a 15ms ping, 4.8MB/s download speed, and 2MB/s upload speed. To test how far the REC15A would go, we had to go outside our house, but unfortunately we noticed it had trouble generating a strong Wi-Fi signal outdoors. Even 20 feet away, it struggled to provide anything stable going through the California stucco walls.

amped | wireless

The REC15A claims to work with "all routers."

All in all, unless you're going outside, we find the REC15A does a respectable job of extending your network coverage. It's generally going to be slower than your router at equal distances, but at $100, we'd say it's fairly priced and should get the job done in most instances. –JIMMY THANG

VERDICT 8

Amped Wireless REC15A

+ GOOGLE FIBER Good software features; easy to install; works for most instances.

− COMCAST Has trouble working outdoors; Wi-Fi connection isn't as fast as router connection.

$100, www.ampedwireless.com

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Deepcool Gamer Storm Maelstrom 240

Wading into the deep end of the pool

This is what the Maelstrom 240 looks like tooled up for Intel CPUs.

DEEPCOOL HAS BEEN AROUND FOR 18 YEARS, but it's kept out of the closed-loop liquid cooling (CLC) fray until now. Its Gamer Storm series includes several CLCs, and the Maelstrom 240 is the top of the line. It's a sleek red-and-black affair with ribbed tubing, sleeved cables, and a slowly pulsing logo on the top of the pump. They've clearly put some work into visual appeal. But since the CLC market has gotten pretty crowded in the last couple of years, we'll need to see performance to match.

Installation is fairly standard. You get two sets of brackets for the pump, one for AMD and one for Intel. Pre-installation of the Intel bracket is common now, but Deepcool leaves that part off. It only takes a minute to put the brackets on, though, and it gives us an appreciation for their machining—these thick pieces of metal are unlikely to bend or dent. The backplate is also thick metal, as are the screws that go through and get secured on the other side.

The cabling is a bit funny, though. Instead of using a splitter cable, Deepcool opted for a triangular bar a few inches long that acts as a fan hub. You get adhesive to stick the bar to a flat surface inside the case, but the gadget itself seems an unnecessary expense. Many builders also prefer to hide as much of their cabling as possible, which makes the hub's relative bulk a little tricky. On the bright side, the hub has connectors to hook up two additional fans.

SPIN CITY

Speaking of fans, the Maelstrom's are encased in hard TPE rubber, which is clever. It helps to reduce noise in a way that doesn't require extra widgets or finicky installation. You just treat them like normal fans, although you have to be careful not to over-torque the screws (the rubber has more give around the corners of the fan).

The Maelstrom doesn't come with software to control the fans, but the light on the pump at least indicates the unit is running. Besides, we can use the "Fan Xpert" software on our Asus Rampage IV mobo. On the "silent" setting, we got good performance when idle and under load, though the cooler didn't perform at the highest tier. When we switched to "Turbo," the fans spun up louder than usual, and the temperatures weren't as good as the noise level would indicate. So at the 240mm level, Corsair still has the best performance we've seen (though its software can be tricky). 280mm coolers, such as the Cooler Master Nepton 280L, still reign supreme in the CLC department. But we can't recommend those universally because the majority of cases on the market aren't large enough.

The gap between the Maelstrom 240 and the Corsair H100i is only a few degrees Celsius, but it means the H100i can also handle higher CPU voltages when overclocking. And the Corsair unit has a five-year warranty, whereas the Maelstrom has a more standard three-year plan. The Maelstrom 240's retail availability was also unclear as this issue went to press. So, if we needed to buy a 240mm CLC right now, it would still be Corsair's H100i. –**TOM MCNAMARA**

VERDICT
8

Deepcool Gamer Storm Maelstrom 240

+ **TOM AND JERRY** Solid cooling; innovative fan design.

− **CAIN AND ABEL** Underwhelming noise-performance ratio; odd cabling.

$106, www.deepcool.com

SPECIFICATIONS

Dimensions (H x D x W)	1.1 x 10.7 x 4.7 inches
Weight	2.45 lbs
Stock Fans	2x 12cm PWM
Socket Support	Intel LGA 1150/1155/1156/1366/2011; AMD AM2/AM2+/AM3/AM3+/FM1/FM2/FM2+
Additional Fan Support	2x 12cm

BENCHMARKS

	Gamer Storm Maelstrom 240 Quiet / Performance Mode	**Corsair H100i Quiet / Performance Mode**	**Corsair H105 Quiet / Performance Mode**	**Enermax Liqtech 240 Quiet / Performance Mode**
Ambient Air	23.5 / 24	**20.3** / **20.5**	22.9 / 22.8	22 / 21.7
Idle Temperature	34.3 / 31.8	**30.7** / 29.3	34.2 / **29.2**	36.3 / 30
Load Temperature	72 / 67	**67.1** / **61**	69.2 / 65	69.7 / 66.3
Load – Ambient	48.5 / 43	46.8 / **40.5**	**46.3** / 42.2	47.7 / 44.6
Street Price	$106	$100	$115	$110

Best scores are bolded. All temperatures in degrees Celsius. All tests performed with an Intel Core i7-3960X at 4.1GHz, on an Asus Rampage IV Extreme motherboard in a Corsair 900D with stock fans set to Standard.

The Lenovo's lack of an SSD really hurts.

Lenovo Y50

Budget in more ways than one

HERE'S A QUESTION we get a lot: "What's the best cheap gaming laptop?" Trying to answer that is tantamount to trying to recommend a budget, luxurious sports car. Lenovo, however, is hoping to champion the conundrum with its new Y50 series notebook. But while our particular $1,240 Y50 is relatively affordable, it's unfortunately cheap in more ways than one.

Its design is very similar to the 15.6-inch Y500 series before it and maintains the brushed-aluminum top, black body, and red backlit keyboard. Besides dropping a 0 from its name, the Y50 is about a half an inch thinner, measuring 15.2 x 10.3 x 9-inches, which is a welcome change. In addition, support for two mobile GPUs in SLI is now removed, which isn't welcome.

One of the Y50's biggest downfalls, however, pertains to its 1080p monitor, which is obviously a TN panel, with mediocre viewing angles that make it look washed-out from the sides. If this were 2012, this would have been more forgivable. But it's two years later, and now we have fancy IPS and UHD tech rocking high refresh rates and whatnot, which makes the Y50's panel look more like a relic with each passing day.

The rest of the specs are a mixed bag. For its CPU, our Y50 was equipped with a 2.4GHz 4700HQ i7 processor, which compared to our Alienware 14 zero point's similar 4700MQ CPU, performed roughly 5 percent better in one of our single-threaded benchmarks, but lagged 20 percent in our multi-threaded tests. We noticed it wasn't hitting its max turbo during multi-threaded loads. We suspect the thinner chassis has something to do with the throttling. The bright side here is that the laptop never got uncomfortably hot or loud. On the graphics side, the Y50's Maxwell-based GeForce GTX 860M with its 4GB of GDDR5 VRAM performed a lot better across the board, as we were seeing 20 to 60 percent higher frame rates in our benchmarks.

TAKING IT SLOW

The laptop came with 16GB of RAM, which is overkill for a gaming notebook considering our unit lacked an SSD. While it does come with an 8GB SSHD, coupled with its 1TB 5,400rpm HDD, it still took 30 seconds to boot. While that may not sound like the end of the world, we've booted up other laptops in less than half that time. In addition, when running our CrystalDiskMark test, it garnered painfully slow sequential read and write speeds of 81.9MB/s and 76.9MB/s, respectively. We would have gladly given up the extra 8GB of RAM if it meant we could get even a small SSD in there. In terms of battery life, the Y50's four-cell, 54-watt-hour battery lasted around 3.5 hours in our video-rundown test, which is pretty typical for its class.

In terms of the built-in peripherals, its red backlit keyboard with chiclet-style keys is very similar to Lenovo's previous Y500 series notebooks, and gets the job done. It also offers two levels of luminescence, or you could turn off the lights if that's more your style. The trackpad is also identical to Lenovo's previous series of gaming laptops and features responsive two-finger scrolling, but again, we don't like the fact it lacks physical buttons and instead opts to have them integrated underneath the trackpad. At least the JBL speakers are crisp and offer ample volume firepower.

At the end of the day, however, the question boils down to whether or not this is a good choice as a budget gaming laptop. We wish we could make a more definitive answer on the subject but its mediocre screen and lack of SSD prevents us from enthusiastically recommending it. That said, if all you care about is portable gaming on a budget, you can't really do better than the Y50 at this price point. –**JIMMY THANG**

VERDICT
8

Lenovo Y50

+ GAME Affordable; capable GPU; relatively portable.

– LAME Mediocre monitor; middling CPU performance; no SSD.

$1,240, www.lenovo.com

BENCHMARKS

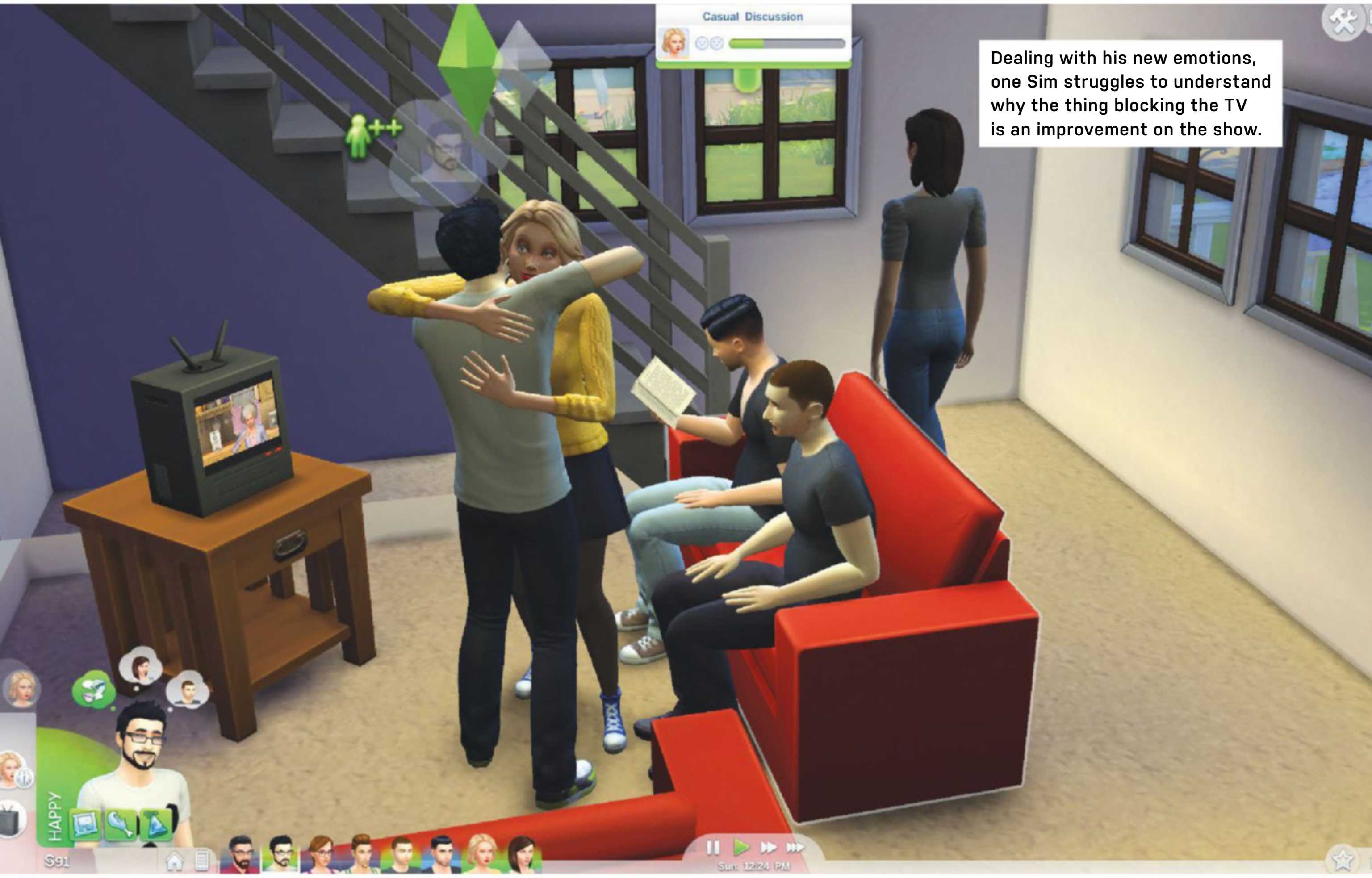
	ZERO-POINT	TESTED SYSTEM
Stitch.Efx 2.0 (sec)	962	1,208 (-20.4%)
Proshow Producer 5 (sec)	1,629	1,556
x264 HD 5.0	13.5	10.5 (-22.2%)
Bioshock Infinite (fps)	36.1	53.13
Metro Last Light (fps)	30.4	50
3DMark 11 Perf	4,170	5,051
Battery Life (min)	234.0	204 (-12.8%)

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Our zero point notebook is an Alienware 14 with a 2.4GHz Intel Core i7-4700MQ, 16GB DDR3/1600, 256GB mSATA SSD, 750GB 5,400rpm HDD, a GeForce GTX 765M, and Windows 7 Home Premium 64-bit. *BioShock Infinite* tested at 1920x1080 at Ultra DX11 settings; *Metro: Last Light* tested at 1920x1080 at DX11 medium quality settings with PhysX disabled.

SPECIFICATIONS

CPU	2.4GHz Intel Core i7-4700HQ
RAM	16GB DDR3/1600
Chipset	Intel HM87
GPU	Nvidia GeForce GTX 860M
Display	15.6-inch, 1920x1080 TN display
Storage	1TB HDD (5,400rpm), 8GB SSHD
Optical Drive	N/A
Connectivity	Ethernet, HDMI, 2x USB 3.0, 1x USB 2.0, audio in, headphone, mic, webcam, built-in Bluetooth, 802.11n, SD card reader
Lap / Carry	5 lbs, 5.7 oz/ 6 lbs, 11.4 oz



Dealing with his new emotions, one Sim struggles to understand why the thing blocking the TV is an improvement on the show.

The Sims 4

Revisiting old haunts and getting all emotional

THERE'S A BLITHE NAÏVETÉ to the way life is presented in *The Sims* that's either comforting or disturbing depending on your mood. It's set in a world where buying things is always awesome and everybody is 25 until they're 60.

Which is fine. Ownership of a beautiful self-built home is a perfectly good fantasy. Nonetheless, we came to *The Sims 4* with a desire to see past experiences deepened by new art and smarter characters. The verdict, on that count, is a partial success. *The Sims 4* inherits an enormous number of its predecessor's ideas, goals, and structures, but it's a sequel in a way that's become peculiar to this series—a fresh start that truncates or removes elements from *The Sims 3* and its expansions in order to begin the cycle all over again. In doing so, developer Maxis has rebuilt the game to support a new style, better animation, and an emotion system that changes its feel and flow.

After sinking 30 hours, we can't imagine being without many of these new features. Multi-tasking is one. In prior *Sims* games, your characters performed tasks as part of a queue. Now, a Sim can cook while talking to their partner, they can paint and flirt, or write a novel and discuss videogames. It feels totally natural, and Sims will, if left alone, occupy themselves with multiple tasks. The days of steering a Sim away from a rigid conversation to watch TV in isolation are gone. Good riddance.

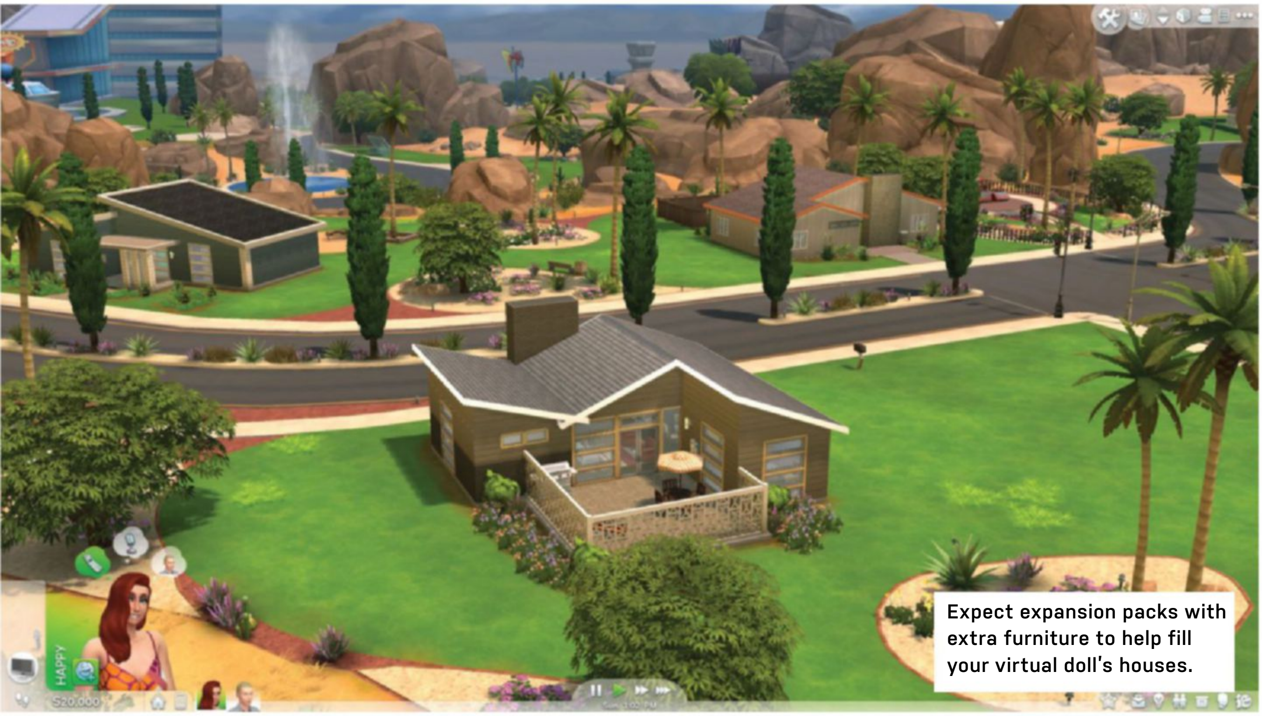
A MOVING EXPERIENCE

This newfound flexibility is matched in a movement system that is—for the most part—far less dependent on an underlying grid. Awkwardness is still a factor, but we experienced far fewer problems.

Yet it's not without flaws. Sims sometimes decide they simply can't go where you want them to—they'll go to a restroom three blocks away, for example, because they've decided they can't get to the one next door. Some of these oddities are new. Some are very, very old. It's easier to forgive the former, filing them under "good intentions." When basic pathing issues are still occurring after *14 years*, it's harder to dismiss.

These details—the positive and the negative—are so important because negotiating them is what you spend your time doing. As a management game, *The Sims 4* isn't challenging. It's about wish fulfillment, and while you earn money, social standing, and career success to achieve those wishes, actually getting there is a matter of time rather than effort. Every Sim has a lifetime ambition, for which the criteria are now more complex, but it really just amounts to a longer list of things to do. It's absorbing, but too straightforward.

This is in spite of the complexity promised by the new emotion system. Sims now



Expect expansion packs with extra furniture to help fill your virtual doll's houses.

have drives that come from their emotional state, and that, in turn, unlocks new actions in the environment. It's a strong addition that adds welcome color, but it's too easy to achieve the ideal emotional state.

Where emotions more clearly show their promise is in the day-to-day interactions between Sims, and in the opportunity they give the game's designers to express a bit of personality. But we wonder about the nature of the person who decided a confident Sim should be able to "pee like a champion," or that an enraged Sim should unlock the power to "have an angry poop."

The system is best when you're steering your Sims directly, discovering new interactions through their feelings. It's less successful as part of the overall game. Without you prompting them into work, love, creativity, or crime, Sims will watch TV until the utilities are shut off. This has always been true, but *The Sims 4* does so much to deepen its characters' internal lives that it's a shame you can't let the simulation run.

Emotions and traits do occasionally create entertaining situations. We watched a mother explain "woohoo" to her son, only for him to become embarrassed and run off to hide. These little moments are great, but they become mere background detail. We never saw a Sim we didn't directly control make a bold decision. There's some sense to that, but we'd have loved the option to let our Sims out into the world.

A note on tone: We've heard a few fans express concern about the way promotional material for *The Sims 4* focused on the gameworld's wackier elements. All of that stuff is present but it's included at your discretion. The grim reaper still shows up when a Sim dies, and from birth to death their lives are touched by silliness, but you're generally free to establish the tone you want for your story.

MEET THE OBAMAS

Neighborhoods have been restructured in a way that will be controversial. There are two "worlds," Willow Creek and Oasis Springs, each with a handful of small areas. You can only load one interior at a time, and traveling between locations involves a (short) loading screen. But individual areas feel more active than they did before and it's possible to customize these small worlds. You can build your own cafés and museums as well as homes, and that encourages the desired degree of personal attachment.

The downside is these places aren't very interesting. During development, a single piece of concept art was shown off multiple times—a strip of moonlit bars along a stretch of river in the bayou, Louisiana. It was an exciting image; it suggested an intimacy and depth of detail that, sadly, this game doesn't match. That strip is in the final game, but it's just a static mesh in the distance, a vision of what might've been.

Of course, that's before players themselves make it so. *The Sims 4*'s build tools are the best in the series. Rescaling rooms is far easier, and the improvements to pathing make unusual setups more viable. We expect to be amazed by what people do.

The same is true for character creation. You can tweak features, body type, and clothing styles, creating copies of yourself, friends, and celebrities to an uncanny degree of accuracy, with the main weakness being that everybody is the same height.

Initially we were skeptical about cloud sharing in *The Sims*, but it's brilliant. The Gallery is a central repository for uploading your designs and downloading other people's. If you want Barack Obama in your neighborhood, simply search for his name. It already feels possible to fill every home in the game with a different Taylor Swift.

Cynicism is sadly warranted by the price, however, of $60—EA knows *The Sims* will always sell. The absence of a microtransaction store makes it feel less like daylight robbery, but you'll probably end up paying for expansions in the future. Despite that, we feel confident in calling this the best *Sims* base game to date. It's the *Sims* you know, but slightly better. No other game offers what it does. There is comfort in that familiar feeling. **–CHRIS THURSTEN**

VERDICT 8

The Sims 4

+ MAKIN' IT: Great creative tools; improved movement; multi-tasking; new emotion system has plenty of potential.

– FAKIN' IT: Too expensive; still annoying pathing issues; new worlds less ambitious than we'd hoped.

$60, www.thesims.com, ESRB: T

LAB NOTES

JIMMY THANG **ONLINE MANAGING EDITOR**

Death to Bad Ports!

Dead Rising 3's appropriately named "Apocalypse" Edition

PC GAMES ARE BUGGY, and console games just work right out of the box—at least that's the stigma that console gamers place on the PC. The fact of the matter is that PC gaming is miles ahead of console gaming, but I have to admit the stigma holds grains of truth.

When *Dead Rising 3* launched on the PC back on September 5, I encouraged a console-playing friend to play the game cooperatively with me on Steam. But upon boot, it felt more like a slideshow than a game. The frame rate performance was truly terrible, which I thought was odd considering I was playing on a powerful rig with a GeForce GTX Titan.

After turning down the settings, I got a modest performance boost, but overall it was still mediocre. After doing some research, I discovered Capcom had limited the game to run at 30 frames per second. D'oh!

DEADRISING 3
APOCALYPSE EDITION

***Dead Rising 3* on the PC is marred by frame rate issues and crashes.**

On the bright side, there's an easy fix to remove the 30fps cap. However, Capcom advises against this because it suggests that 1) users might need really beefy hardware and 2) it could potentially cause issues. Even ignoring the Capcom warnings, the fan-made fix reinforces the negative stereotype that PC gamers always need to manually tweak their games just to play them properly. The very least Capcom could have done here is to include an in-game menu option to remove the annoying 30fps limit.

Performance issues aside, *Dead Rising 3*'s frame rate is hardly the most pressing issue with the game at the moment. When my friend and I were slugging our way through the co-op campaign, the game crashed on us multiple times; after four crashes in an hour, even I had to admit defeat. I later heard that tons of users were experiencing the same issues.

So, I'd like to take the time to say this to Capcom and other game developers: PLEASE STOP THE LAZY PC PORTS! These buggy, un-optimized ports do nothing to bolster the sales of your games. Even more importantly, your rush jobs give PC gaming an undue bad rep.

GORDON MAH UNG

Editor-in-Chief

I'm spooling up a blue-on-blue test using Intel's quad-core Core i7-4790K "Devil's Canyon" and the hexa-core Core i7-5820K "Haswell-E Lite" for the next issue, to see which is worthy of your dollars at the sweet spot most enthusiasts are shopping at. My early bet is on the 5820K, which has a better roadmap and more capability. That said, it does cost more to buy into Intel's new LGA2011-V3, instead of sticking with the cheaper LGA1150 platform. I'll weigh the cons and measure the potential and report back on which is the wiser buy.

TOM MCNAMARA

Technical Editor

I got a whirlwind tour of Nvidia's new Maxwell cards recently (more to come on that next month). These video cards are doing some neat stuff; I think people are going to like using dynamic super resolution to get 4K pixel density without having to buy a 4K monitor (though they'll still need lots of horsepower). On the other end of the spectrum, multiframe antialiasing should help budget-oriented gamers with their frame rates. It also makes me wonder what kind of counter-attack AMD has in store.

First Look: Hands On With Dell's 5K Monitor

Over 70 percent more pixels

The 5K panel has a glass sheet over its antireflective coating.

THE DAY AFTER you bought your Pentium, the Pentium II came out. Just as you passed the time limit to return your GeForce GTX 680, the GeForce GTX 780 was announced. Well, guess what? Just as you broke the seal on your shiny new 4K monitor, Dell has stepped in to rain on that parade too, with the first 5K monitor: The UltraSharp HD 5K UP2715K.

If you think it's only 1K better, you're wrong. A standard Ultra HD monitor packs resolution of 3840x2160, or about 8.3 million pixels. Dell's new UP2715K has a resolution of 5120x2880, or 14.7 million pixels. That's roughly 70 percent more pixels. In pixel density, that's about 218 pixels per inch for the UP2715K. And no, don't call it "Retina."

Dell hasn't disclosed the panel tech yet, but since it won't be a budget item, it's unlikely to be TN. It's also initially being aimed at professional markets such as medical, which can use the resolution. There's some conjecture that Dell made the 5K panel by fusing two panels together, which isn't unheard of. The Asus PQ321 was made using a similar technique, as were others.

The panel has two DisplayPort 1.2 connectors but, because a single DisplayPort 1.2 can't handle the bandwidth, both connections must be used. If you're wondering why Dell didn't use a DisplayPort 1.3 connection, the spec was announced too late and isn't expected to make it onto monitors for some time. DisplayPort 1.3 increases bandwidth to 32.4Gb/s, while 1.2 can handle 17.28Gb/s, which also doubled it from the original DisplayPort 1.0 of 8.64Gb/s.

Portrait mode, in case you want to view your 14.7 million pixels vertically.

With both of the DisplayPort ports used simultaneously, don't expect to drive more than one display signal at full resolution. Dell did integrate a third Mini DisplayPort connector, but that signal doesn't support the native resolution of the panel. Instead, it upsamples it from the lowly 4K resolution.

Among other features are an antireflective coating with a glass layer. It also supports portrait mode. We got to play with the monitor hooked up to a system with a Quadro K5000 graphics card. The video, as expected, was phenomenal, but there were stretches of heavy compression artifacts. That's not the monitor at fault, though. It was the video, which was 5K-encoded using the new H.265 codec. Despite using it in a brightly lit room with windows everywhere, reflections were kept to a minimum. That can't be said for lesser monitors.

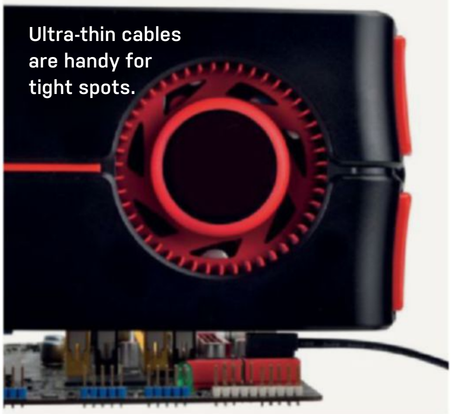
The monitor itself is expected to be available by the end of this year for $2,500. You might balk at the price in light of 4K panels now pushing $600. But compared to the price of 4K panels at introduction, it's not that bad. The Asus PQ321, for example, was $3,500 initially. Granted that was a much larger 32-inch panel, but $2,500 isn't as bad we'd expected. **–GU**

GEEK TESTED & APPROVED

SilverStone Ultra-Thin SATA Cable

YOU GET SATA CABLES for free with your motherboard, so why pay $12 for one? Well, Silverstonetek's CP11B makes its case with a new version of its ultra-thin SATA cable. These thin cables are a lifesaver to anyone building in the tight confines of a micro-tower or small form factor, where thick, bulky, and long SATA cables simply get in the way. Even those building in a full-size giganormous tower case can use these thin cables to reach poorly placed SATA ports on motherboards that are sandwiched under the GPU. The original CP11s were 300mm and blue, but the newer black models come in both 300mm and a longer 500mm length. **–GU**

$12, www.silverstonetek.com



Ultra-thin cables are handy for tight spots.

LETTERS

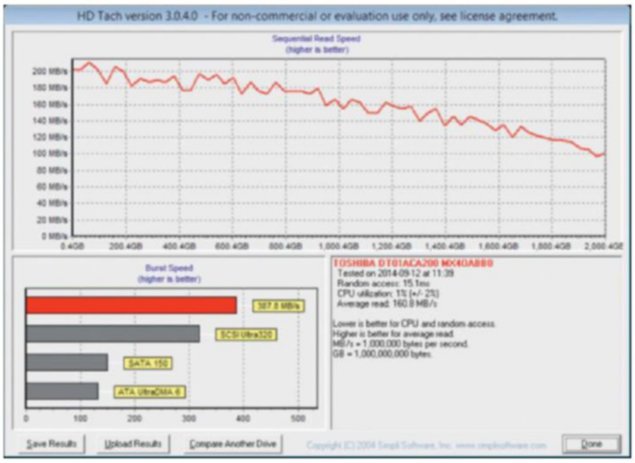
WE TACKLE TOUGH READER QUESTIONS ON...

> HDD Degradation
> Our Mental Health
> Case Windows

Degrading Hard Drive

A while ago, I read in *Consumer Reports* magazine that a hard drive's performance starts to degrade once it reaches 50 percent capacity. I know hard drives need a certain amount of free space to properly operate, but thought it was around 15–20 percent. Was *CR* correct? **—Tara Taylor**

EDITOR-IN-CHIEF GORDON MAH UNG RESPONDS: It depends on how you define "degrade." I would say 50 percent is a bit extreme. Remember, a hard drive is still a platter-based medium and much like a DVD or CD, the performance is usually greater at the outer edges of the platter. As a quick test, we fired up the old HD Tach benchmark on the Polywell we reviewed this month. It has a 2TB 7,200rpm Toshiba hard drive with a 64MB cache. As you can see, the drive gives read speeds starting in the 200MB/s range but as the heads cross the platters, performance degrades. By the end of the read, it's roughly 100MB/s, or half the performance. Still, even at 75 percent full, the drive's read speeds are about 140MB/s, so *CR*'s estimate may be a bit pessimistic. One method to keep your drive consistent is to "short stroke" it by creating and using a partition that is contained within the portion of the drive that's the fastest. For example, you could partition that 2TB drive as a 1TB drive and see your average performance in the 180MB range across the entire partition. But that's thinking in a pre-SSD world. If you want speed, use an SSD. An HDD's job today should be to store as much data as possible. Run a 4TB drive with your SSD and don't think about it. Although SSDs also degrade as capacity drops due to how they function, I don't think you'll "feel" it as much.


HD Tach version 3.0.4.0 - For non-commercial or evaluation use only, see license agreement.
Sequential Read Speed
(higher is better)
200 MB/s
180 MB/s
160 MB/s
140 MB/s
120 MB/s
100 MB/s
80 MB/s
60 MB/s
40 MB/s
20 MB/s
0 MB/s
0.4GB
200.4GB
400.4GB
600.4GB
800.4GB
1,000.4GB
1,200.4GB
1,400.4GB
1,600.4GB
1,800.4GB
2,000.4GB
Burst Speed
(higher is better)
387.8 MB/s
SCSI Ultra320
SATA 150
ATA UltraDMA 6
0
100
200
300
400
500
Save Results
Upload Results
Compare Another Drive
Done

TOSHIBA DT01ACA200 MX4OABB0
Tested on 2014-09-12 at 11:39
Random access: 15.1ms
CPU utilization: 1% (+/- 2%)
Average read: 160.8 MB/s

Lower is better for CPU and random access.
Higher is better for average read.
MB/s = 1,000,000 bytes per second.
GB = 1,000,000,000 bytes.

A hard drive's read performance drops as the heads cross the platter, but not as drastically as many assume it does.

CUT, COPY, PASTE

* The title of Tom Halfhill's "Fast Forward" column was incorrect in the October 2014 issue (page 13). It should have been "The Tortoise Beats the Hare." We're sorry, Tom!

Building an Area-51

I have a 2008 version of the Alienware Area-51 7500 GC system. I really like the case, so wonder if it would be possible to use a third-party motherboard in it. I haven't built a PC in a long time, and wanted to know if it would be possible to save on the purchasing of a case. **—Michael Sweatt**

EDITOR-IN-CHIEF GORDON MAH UNG RESPONDS: The answer is most likely yes, but we're not absolutely sure. For the most part, Alienware has used off-the-shelf components on its machines, even after being bought by Dell. The only sticky part could be if Dell put extra mounts in the case to strengthen the CPU cooler for shipping and the front panel connector. The only way to find out would be to pull the board out, but my gut says you'd be OK. Alienware, if I recall, uses a single connector for the front power button, reset, and lights. Asus and Asrock don't follow that layout, so you'll have to split the connector to use the front power buttons. Gigabyte, MSI, and most others use that same layout, though.

Oh, the Insanity!

Well, I have to say this. Are you all nuts?! $30K for a single PC? Sure, it's two complete builds in one box, but still. I do love that desk/case, though. One question: Is there only one shelf, or

↘ submit your questions to: comments@maximumpc.com could you add more? I'm thinking about getting it, but would like to put my NAS, router, and printer out the way. Otherwise, you're all insane. I can't wait until next year's Dream Machine! Also, could I have an extended loan on one of those Titan Zs? Pretty please?

—Terry Matthews

EDITOR-IN-CHIEF GORDON MAH UNG RESPONDS: We don't see it as a nutty build as much as an investment in pure joy. The Cross Desk features shelf mounts on both sides that vary in height. I don't see why you couldn't run multiple shelves, but you wouldn't have that much space between the shelves. Sadly, the liquid-cooled Titan Zs are in an undisclosed location for their own safety.

A Rig with a View

What is your fascination with windowed cases? Are you guys a bunch of hippies (not that there's anything wrong with that)? Or maybe you guys are from Colorado and like to toke a joint or two upon completing a build, and then turn off the overhead lights to then gaze at all the spinning fans along with all the colored lights? Seriously, if there is a value in the side windows? Please let me know.

—RT

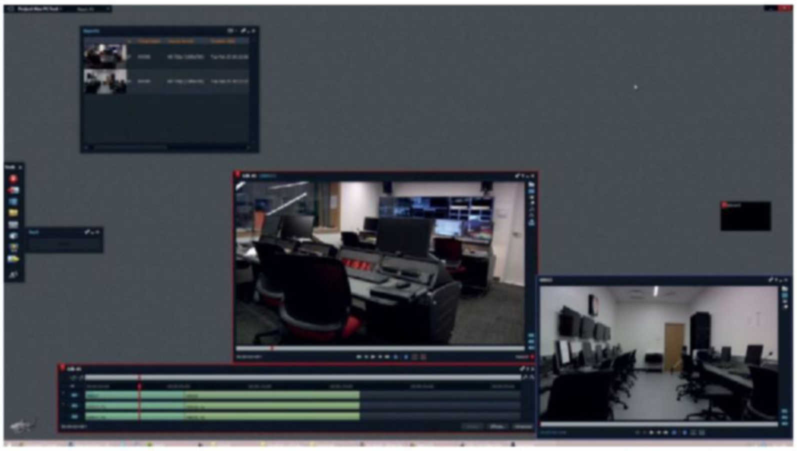
ONLINE MANAGING EDITOR JIMMY THANG RESPONDS: You'd think there might be some cooling benefit in case windows, but unfortunately, they do nothing to make a PC thermally cooler. However, they do wonders for a system's aesthetic coolness. The main reason we like them is because when we've spent a pretty penny putting together some nice components we want to show them off, dammit! Plus, who doesn't like looking at fancy LED lights from time to time? As for your toking question, errr... let's just say we didn't inhale.

> MAYBE YOU GUYS ARE FROM COLORADO AND LIKE TO TOKE A JOINT OR TWO UPON COMPLETING A BUILD.

[NOW ONLINE]

BEST FREE VIDEO EDITOR ROUNDUP

As fun as watching YouTube videos can be, it's much more satisfying and rewarding to make them yourself. In the past, you had to throw down a big chunk of change to get yourself some decent video-editing software. While that expensive software certainly isn't obsolete, if you're not planning on going pro and simply want something to make home movies on, you'll be surprised at how far some of the free video-editing software has come. To help you out, we've conducted a roundup of seven of the best free video-editing apps. http://bit.ly/MPC_freevid



Facebook Polls

What's Your Best Ever Tech Present?

In honor of our "Gift Guide" this issue, we reached out to our Facebook readers and asked them to share some of their tech gift memories with us. Here are some of our faves.

Tomm Munro One of the first digital watches. Big, red LED numbers. Was around $800 at the time. Now you get them in gumball machines.

Dylan Kuehl My brother hooked me up with a gaming laptop, my first time playing games that weren't *Minecraft* or *League of Legends*. Was glorious!

Alex Cutadean The original Gameboy, which still works.

Steven Leblanc My wife bought my Cosmos II for our anniversary, then a 28-inch Samsung 4K monitor for my birthday the next week.

Daniel J. Hill *Maximum PC* subscription.

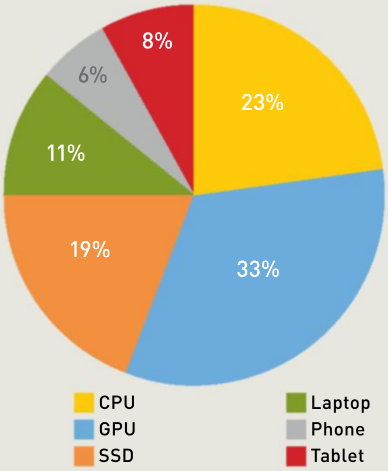
Jody Mayer NES bundle with lightgun, two controllers, and dual *Mario*/*Duck Hunt* cart on Christmas morning 1989.

Duane Dehnert Windows 98 Plus, and the thrill of desktop themes.

Mark Hutchings Packard Bell 286. Parents paid over $2,300 for it. Changed my life forever.

Rob Kingsboro The "family PC" when I was 10. An IBM PS/2 Model 30. It came from a store called Zayre, where I remember playing for hours at NES/Sega demo stations while my parents shopped.

What Tech Gift Are You Hoping Santa Brings This Year?



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MAXIMUM PC AT ITS BEST
ANYTIME, ANYWHERE!

HELLO, 4K LCD! Asus 31.5-inch panel boasts four times the resolution of 1080p PG. 76

AC ROUTERS ARRIVE Seven 802.11ac Wi-Fi routers demo the new spec's capabilities PG. 34

ASROCK M8 Build your own micro-tower with this BMW-designed bare-bones kit PG. 74

MAXIMUMPC

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SUPERCHARGE YOUR PC

MOVE YOUR OS TO AN SSD AND REAP AMAZING REWARDS—WE SHOW YOU HOW! PG. 22

BUILD IT: AMD's R9 290X in a small form factor PC! PG. 58

Future

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THE BUILDS

BUDGET GAMER

INGREDIENTS

PART			PRICE
Case	NZXT Source 210 Elite		$50
PSU	Corsair CX500 500W		$50
Mobo	Gigabyte GA-H97M-HD3		$85
CPU	Intel Core i3-4150		$117
GPU	Sapphire Radeon R9 280 3GB 100373L		$190
RAM	2x 4GB G.Skill Sniper Series 8GB (2x4GB) DDR3/1866	**NEW**	$75
SSD	128GB SanDisk Ultra Plus	**NEW**	$66
HDD	Seagate Barracuda 1TB		$60
OS	Windows 8.1 64-bit OEM		$100

Approximate Price: $793

OUR BUDGET GAMING BUILD doesn't drastically change this month, but it's still a hell of a deal for the money. We've switched our RAM to two 4GB sticks of DDR3/1866 G.Skill, as the Patriot sticks were unavailable. Solid-state drive pricing continues to astound us, so we've dropped the Crucial MX100 for a 128GB SanDisk Ultra Plus. Our last consideration is the GPU. We decided to stick with our Radeon R9 280. We considered paying $50 more for the new Radeon R9 285 card, but in the end, we decided to hold off until its price stabilizes. There is a good chance the Radeon R9 280 will be off store shelves by the time you read this, though. So if you want a replacement, reach for a 285.

MIDRANGE

INGREDIENTS

PART			PRICE
Case	Corsair Vengeance C70		$108
PSU	EVGA 220-G2-0850-XR 850w		$115
Mobo	Gigabyte GA-G1.SNIPER Z97		$161
CPU	Intel Core i5-4690K		$240
Cooler	Cooler Master Nepton 280L		$120
GPU	Sapphire TRI-X OC Radeon R9 290		$415
RAM	2x 4GB G.Skill Sniper Series 8GB (2x4GB) DDR3/1866	**NEW**	$75
Optical Drive	Samsung SH-224DB/BEBE		$20
SSD	Crucial MX100 256GB		$116
HDD	Seagate Barracuda 3TB ST3000DM001		$103
OS	Windows 8.1 64-bit OEM		$100

Approximate Price: $1,573

OUR MIDRANGE CONTINUES to be a solid pick for enthusiasts with limited budgets, whose tasks don't need the extra performance boost you get from Hyper-Threading. We don't make many major changes this month, besides the RAM, which has near-constant price fluctuations. This unlocked Core i5 can be overclocked with very little effort, and the Sapphire Radeon R9 290 card is hot to trot. That's enough firepower to play any game at 1080p without compromise. Nvidia's GeForce GTX 980 is on its way, but $550 is a little high for this tier. The GTX 970 at $329 sounds enticing too. It wasn't available as this issue went to press, but it could prove an appropriate replacement.

TURBO

AT THE TURBO LEVEL, we've decided to look forward, so we're dumping the Core i7-4790K "Devil's Canyon" CPU for Intel's hot new Core i7-5820K chip. While both CPUs use the Haswell microarchitecture, the Core i7-5820K is a six-core chip versus the Core i7-4790K's four. For multi-threaded loads, that's a huge deal for an additional $40 (for the CPU itself). That CPU also requires pricier LGA 2011-3 motherboard and DDR4 instead of DDR3. For that, we turned to Gigabyte's GA-X99-UD4 board. For an X99 board, it's almost affordable and features two M.2 slots and SATA Express. We decided to shell out another $20 to get 16GB of Crucial Ballistix DDR4/2400, for the extra clock speed. Our final big change is ejecting the hotter Radeon R9 290 cards for the faster, quieter, and more power-friendly new GeForce GTX 980 cards. That's a pricier GPU, but we backed out our PSU to 750 watts on the Corsair RM750. Since the 980s have a TDP of only 165 watts, 750 is totally fine—though we may add more power for a third card.

For more of our component recommendations, visit www.maximumpc.com/best-of-the-best.

INGREDIENTS

PART			PRICE
Case	NZXT Phantom 530		$130
PSU	Corsair RM750	**NEW**	$109
Mobo	Gigabyte GA-X99-UD4	**NEW**	$258
CPU	Intel Core i7-5820K	**NEW**	$385
Cooler	NZXT Kraken X61		$140
GPU	2x GeForce GTX 980	**NEW**	$1,100
RAM	4x 4GB Crucial Ballistix Sport DDR4/2400 4x4GB	**NEW**	$234
Optical Drive	LG Blu-ray Burner WH16NS40		$70
SSD	Samsung 840 EVO 500GB MZ-7TE500BW		$250
HDD	Seagate Barracuda 3TB ST3000DM001		$103
OS	Windows 8.1 64-bit OEM		$100

Approximate Price: $2,879

UPGRADE OF THE MONTH

ASUS PG578Q

It's not cheap, it's not perfect, and it's just a little disappointing—but the 2560x1440 Asus PG578Q is still one of the nicest gaming monitor upgrades available as we go to press. It features Nvidia's cool G-Sync technology that all but obliterates screen tearing, even at lower frame rates. **$800, www.asus.com**

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